“THE GARDEN IS A LABORATORY:” CLIMATE SMART AGRICULTURE AND THE CULTIVATION OF JUST FUTURES IN CAUCA, COLOMBIA

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ABSTRACT

Molly E. Green:"The Garden Is A Laboratory:" Climate Smart Agriculture and the Cultivation of Just Futures in Cauca, Colombia
(Under the direction of Florence Babb)

As climate change increasingly impacts smallholder farmers across the world, research is needed to understand how adaptive technologies affect social and productive life. As such, this dissertation investigates the development and deployment of "climate smart agriculture" (CSA) in Colombia. Climate smart agriculture is a development framework that aims to prepare farmers for climate change and, as a result, to ensure a future food supply. This is primarily accomplished through the development of climate smart agriculture tools, technologies, and practices (CSAs). Tacking between the research institution where CSAs are developed—the International Center for Tropical Agriculture in Cali—and the farming communities where they are tested and implemented in Colombia—the "climate smart village" in Cauca—I analyze the limitations and possibilities that CSA brings to farmers.

CSAs are increasingly promoted throughout the world to help farmers combat the negative impacts of climate change despite critiques that CSAs fail to address systemic causes of inequalities in hunger and reproduce systems of oppression. However, my research suggests that these critiques, while valid, overlook how farmers are leveraging CSAs to construct community-centered visions for the future. My research in Cauca illuminates how women are using CSAs as part of reclaiming traditions and control over the local food system, challenging gendered power dynamics, and constructing social networks that increase adaptive capacity and women's collective power. Women in the Cauca climate smart village have notably come to use CSA-

related products to build local economies as an alternative to capitalistic models and to foster networks of support and reciprocity.

Despite the positive changes that CSAs catalyzed in Cauca, ultimately I argue that CSAs fail to provide us with an approach to the agricultural sector that will guarantee sustainable and diverse food systems that will feed a future world impacted by climate change. A truly transformative approach to global food systems, I suggest, would entail centering the visions and approaches of local communities in addressing climate change as they construct economies, technologies, and futures outside of the limitations of a system invested in capitalist accumulation.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF ABBREVIATIONS

CCAFS	Climate Change, Agriculture, and Food Security
CGIAR	Consultative Group for International Agricultural Research
CIAT	The International Center for Tropical Agriculture
CSA	Climate Smart Agriculture
CSAs	Climate Smart Agricultural Practices and Technologies
DAPA	Decision and Policy Analysis
ESMAD	Escuadrón Móvil Antidisturbios (Colombian National Police Riot Control)
FAO	Food and Agriculture Organization
GMO	Genetically Modified Organism
NGO	Non-Governmental Organization
SDGs	Sustainable Development Goals
SENA	Servicio Nacional de Aprendizaje
STS	Science and Technology Studies

CHAPTER 1: INTRODUCTION: CLIMATE SMART AGRICULTURE AND TECHNO-FUTURES

There is overwhelming evidence that climate change is making agricultural production increasingly difficult for farmers across geopolitical contexts (IDEAM 2010; Yadav et al. 2015). In response to these challenges, "climate smart agriculture" (CSA[1]) has been proposed by development and research institutions. Climate smart agriculture, the focus of this dissertation, aims to sustainably prepare farmers for the impending effects of climate change through the widespread dissemination of technological advancements and productive strategies. Overall, CSA aims for a paradigm shift in agricultural production to ensure the viability of a future world threatened by climate change. However, despite good intentions from those developing this new productive paradigm, CSA presents certain limitations for imagining and creating a just and equitable future.

This dissertation addresses CSA in both institutional and local contexts. I explore the processes behind the development and dissemination of CSA and the ways that it is translated into a local context as farmers and their families in Colombia use CSA and its associated technologies and practices to create agency, hope, and resiliency in the face of a changing climate. Between August 2017 and November 2018, I conducted 14 months of dissertation research[2] at a leading research institution developing and promoting CSAs—the International

[1] I use CSA to refer to climate smart agriculture as a development paradigm and CSAs to refer to the specific practices and technologies that are categorized as climate smart.

[2] Although data for my dissertation was collected in these 14 months, I have worked within CIAT for a longer period of time. I first interned for a year at CIAT for the Gender and Climate Change Team in 2013 and had

Center for Tropical Agriculture (CIAT) in Cali—and in a group of communities in Cauca, Colombia that served as a "living laboratory" for testing CSA technologies and practices (collectively called a "climate smart village" by CIAT). Broadly, I argue that although CSA may fail to address the systemic causes of climate change and disparities in hunger globally, we cannot discount the ways that local communities are using these tools and technologies to construct futures that push back against the corporatization and technological reliance of the agricultural sector by multinational businesses, researchers, and scientists.

CIAT, CCAFS, CSA, and Climate Smart Villages

Figure 1: Map of Colombia with CIAT and the Cauca climate smart village marked

subsequent visits back to CIAT and to the Cauca climate smart village during the Summers of 2015 and 2016. Because of this long period of time, I have been able to observe the development and growth of the Cauca climate smart village from the initial planning phase.

CIAT is one of the institutions—alongside the World Bank and the Food and Agriculture Organization of the United Nations (FAO)—leading the development of and research on CSAs. The specific program at CIAT that leads this initiative is the research program on Climate Change, Agriculture, and Food Security (CCAFS). I spent roughly a third of my time in the field at CIAT's large campus among the sugar cane fields in Valle de Cauca, attending meetings, conducting interviews, and sharing research results. While CIAT contains numerous research groups and labs dedicated to agricultural research in various buildings, I mainly occupied the buildings where the research teams forming part of the the Decision and Policy Analysis (DAPA) arm of CIAT were located. These two buildings, cheekily referred to as "Motel One" and "Motel Two" because they looked like motels with a row of doors opening into an inner courtyard, house the researchers dedicated to the human dimensions of agriculture and climate change and bring together teams of researchers with broad areas of expertise from nutrition to economics. CCAFS is located across the street from Motel Two in a newly remodeled building.

A short walk away from the buildings dedicated to DAPA's research teams is an outdoor coffee kiosk and patio where I spent hours drinking over-roasted coffee and chatting with soil scientists and agronomists about their research at CIAT. Beyond the cluster of DAPA's buildings are the labs and fields where entomologists, agronomists, and soil and seed scientists run their experiments, sometimes carefully covering large sections of fields in houses made of netting to prevent birds or insects from carrying off experimental seeds. During my fieldwork, an enormous new seed bank was being constructed on the edge of one of the experimental plots as part of international efforts to collect and store seeds to preserve the world's seed biodiversity and for research to ensure future food security. Although I did not see the completion of the seed

bank, its construction marked CIAT's commitment to feeding a future world that I delve into in future chapters.

I spent the rest of my time in the Cauca climate smart village where researchers implemented and tested CSAs alongside local farmers in Cauca, Colombia. The Cauca climate smart village is located outside of the capital city of Cauca in the department bordering Valle de Cauca, in the foothills of the Andes. I spent my days in the Cauca climate smart village helping build gardens, organize and attend workshops and trainings, and participating in the daily life of the community. Over the course of the seven years that I periodically worked in the Cauca climate smart village, I watched as women of all ages emerged as community leaders and as social networks expanded and strengthened around exchanges of seeds and garden products. Central, although not exclusive, to shaping the activities in the Cauca climate smart village was climate smart agriculture.

Climate smart agriculture is a development paradigm that aims to meet three objectives: to sustainably increase food security through increasing agricultural productivity, to build resiliency and adaptive capacity of farmers, and to reduce greenhouse gas emissions of the agricultural sector (Lipper and Zilberman 2018). CSA aims to address both the short term and long term impacts of climate change (Lipper et al. 2014). CSAs—or the specific tools, practices, or technologies associated with CSAs—are multilevel. CSAs encompass both on-farm technologies and practices (new seed varieties, methods of soil management, etc.) used by farmers and civic engagement at national and international levels through policy and diagnostic and prescriptive tools.

Although this approach diverges from past development initiatives in its broad scope, in farming communities the strategies that are most used, the most observable, and have the most

impact are CSA practices and technologies. The CSA tools and practices used on farms are first tested by farmers (with the support of CCAFS researchers) in groups of communities called climate smart villages, which are located throughout the world. Once a CSA has been refined through this process of on-the-farm testing with a particular farmer or with a small group of farmers, CCAFS seeks out strategies to spread the CSA to other in-country regions or to other nations.

Farmers are rarely involved in the civic engagement strategies, including in regional or national level policy formation that will have an indirect impact over their lives. During fieldwork, I observed that when farmers were invited to engage in the formation of policy, their participation was often superficial and discussions were driven by governments and other stake-holders in these meetings rather than by farmers themselves. Farmers, therefore, primarily experienced CSA as a wide set of agricultural technologies and practices that aim to increase production.

CSAs in the Cauca Climate Smart Village

Because the political, social, and environmental factors vary among climate smart villages, each village has a different focus. In the Cauca climate smart village where I worked, the focus was on increasing food security although efforts were made to fulfill all three pillars of climate smart agriculture mentioned above (i.e. mitigation of greenhouse gases, increasing farmer resiliency, and bolstering food security). With increasing food security as the primary goal, several CSAs were developed and heavily promoted in the Cauca climate smart village that aimed to increase the production or resiliency of crops for household consumption. By comparison, in other climate smart villages, adaptive interventions for cash crops have been the primary focus. For example, in Bihar, India, climate resistant rice and wheat varieties were introduced to farmers to increase their production primarily for markets rather than for their own

households. I provide more details on the context of the climate smart village in Cauca in Chapter 2 and focus here more narrowly on the CSAs implemented in that region.

The Cauca climate smart village is located a four to five hour bus drive southwest from Cali, close to the city of Popayán in the department of Cauca. Frequent protests from different Afro-Colombian and Indigenous communities during my fieldwork blocked the Panamerican highway running between Cali and Popayán as these communities demanded that the government provide better services and assurances of safety from the ongoing armed conflict between guerrilla and paramilitary groups.[3] During the first six months of my fieldwork, I was frequently caught on the edges of conflicts between community members and ESMAD (heavily armed riot police) as ESMAD tear-gassed protesters to clear the Panamerican highway. Although civil unrest swept the department of Cauca during my fieldwork, farmers in the Cauca climate smart village did not participate in protests, nor see any reason to participate. Many of the farmers that I saw regularly commented that the protests were a nuisance, despite sharing similar concerns to those of the protesters about the failures of the Colombian government—a theme that appears in future chapters.

[3] The decades-long armed conflict in Colombia has shaped rural and urban landscapes alike and has created lasting challenges for farmers in Cauca. At the time of congressional approval of the peace accord in November 2016, the citizens of Colombia had endured more than 50 years of war that resulted in the deaths of over 260,000, the disappearance of 60,000, and the displacement of over 7 million people. The accord resulted in the demilitarization of the Revolutionary Armed Forces of Colombia (FARC) and facilitated their transition into a new political party. Although the FARC is no longer engaging in guerrilla warfare, other militarized actors, including the National Liberation Army (ELN) and paramilitary groups, continue to perpetuate widespread violence in rural areas. CIAT director Jesús Quintana was recently held in Toribío, Cauca by an armed group (he was later released) and encounters between armed groups and military forces frequently appear in the news. The ongoing violence has, in particular, impacted women across racial and ethnic groups and Afro-Colombian and indigenous groups and has led to the stigmatization of rural peoples and land disposession (LeGrand et al. 2017; Meger and Sachseder 2020).

Early in my fieldwork, several community members in the Cauca climate smart village explained to me that so many farmers, including neighboring communities a walkable distance from Los Cerrillos, depended on coca production because a lack of transportation-related infrastructure made it arduous or impossible to transport crops to centralized markets. Although the communities in the Cauca climate smart village have been untouched by the violence directly, they too feel the effects of an absent government and weak infrastructure. While I do not discuss in-depth the armed conflict throughout my dissertation, it is important to acknowledge here that rural landscapes and people—including the communities in the Cauca climate smart village—have been deeply affected by ongoing violence that has made earning livelihoods and healthy and safe communities challenging.

From the northernmost neighborhoods of Popayán, a long dirt road winds directly west through the gently sloping foothills of the Andes mountain range until it ends at the beginning of a mining operation located alongside the Magdelena River. This road provides an access point to many of the 14 separate communities that compose the Cauca climate smart village. It was in four of these *veredas* (parishes)—Los Cerrillos, El Danubio, Las Mercedes, and San Antonio—that I conducted most of my research with farmers and participated in community meetings and activities.

As one of the researchers at CCAFS' partner organization in Popayán, Ecohabitats, told me, this area was selected to be the Colombian climate smart village for several reasons. These communities were a relatively short drive away from CIAT, allowing researchers to make frequent daytrips for fieldwork and for visitors from the government or other research institutions to easily take a trip to the climate smart village. Cauca has also been identified as one of the regions that will be most affected by climate change, both because it is composed of smallholder farmers, who are more vulnerable to climate change, and because the specific geography of the region is anticipated to experience strong changes in weather patterns.

Additionally, this region of Cauca has been exceptional in several respects. As community members shared with me, they never experienced the violence associated with the ongoing armed conflict between the paramilitary and the FARC and the ELN that has devastated other communities, including ones just across the River Magdelena that are visible from Los Cerrillos. This was because, many community members guessed, their communities were not strategically located; guerrilla forces could be easily trapped along the river banks and they were too accessible by military and paramilitary forces from Popayán to make coca growing feasible. Finally, the community leadership of Los Cerrillos had a long history of being politically active

and of advocating for local needs, and had a strong and united leadership body that represented all of the 14 communities.

I selected the Cauca climate smart village to work in because it was one of the most well-developed and well-funded villages out of all of the climate smart villages around the world and one of the earliest formed. In Latin America, this village was understood to be the model village where CSAs were frequently first developed and tested before being exported to other climate smart villages in Central America (those in Guatemala, El Salvador, and Nicaragua). The proximity to CIAT, where CCAFS is headquartered, also allowed me to travel frequently between these two sites and to gain a better understanding of how practices and knowledge traveled between these two sites.

On CCAFS' website, there is a long list of adaptive practices and technologies that have been introduced in the Cauca climate smart village. However, only a few select practices were used by multiple families or widely taught to farmers in the Cauca climate smart village. Because it is difficult to draw conclusions about practices deployed on a limited number of farms, I focus on the CSAs most widely implemented or discussed. The widespread CSAs include climate adapted and biofortified bean varieties and different variations of climate smart home gardens.

The CSA home gardens were developed by CCAFS' local NGO partner, Ecohabitats, in collaboration with the president of the local governmental body (the *junta communal*), Jimmy Mañunga. Luis Ortega, one of the founders of Ecohabitats, explained to me that the adaptive home gardens were developed from other examples of gardens that he and Jimmy had seen in person and online in other communities inside and outside of Colombia. Once they had the initial design, they integrated materials that were traditionally used locally for construction.

CSA gardens were built to respond to early assessments of vulnerability measured by CCAFS and Ecohabitats and to the often discussed productive challenges that women pointed out to me during my first summer of fieldwork in 2015. Namely, the gardens were designed to protect plants from seasonal heavy rains—which would damage delicate crops—and to make garden watering easier during the dry season. In the past, women usually abandoned their gardens during the dry season in August because, as they told me, it was too time consuming and difficult to carry water from the many small streams running down the mountain toward Rio Magdalena and too expensive to use the water that was piped into their homes. The CSA garden developed by Ecohabitats aimed to address both of these climate related difficulties and problems of access to water.

Figure 2: Climate smart garden with plastic covering and water tank with drip irrigation

Photo credit: author

The gardens shared a few technological elements that made them "climate smart." A bamboo structure covered with a giant sheet of plastic as a roof encloses the gardens so that they look somewhat like a house without walls. Just below the plastic roof, bamboo pipes direct

rainfall into enormous storage tanks positioned alongside the gardens. Attached to the storage tank is a sturdy hose that runs into the gardens where it is connected to drip tape, a flimsy hose with small holes in it at regular intervals to allow water to seep out. The drip tape is stretched out lengthwise along the raised beds and feeds water—drip by drip—to the plants.

There are several variations of this garden. In the most basic model of this garden, the garden beds are organized in rows parallel to each other. In another version, the circular garden, the beds are arranged in concentric circles around a central, circular raised bed. Relatively few farmers in the Cauca climate smart village implemented a circular garden, but those that did were the envy of neighbors and visitors alike.

Figure 3: Members of the association "Tierra, Vida y Amor" build a CSA circular garden

Photo credit: author

A third version of the climate smart garden is a vertical garden created for farmers who have limited available land around their houses to plant a garden. In this model, holes are cut in PVC pipes at regular intervals and mounted to an outside wall. The PVC pipes are filled with soil and planted, and a surprising number of herbs and vegetables grow out of the openings cut into the pipes. The water collection tank is usually mounted on the roof of the structure that the vertical garden is attached to and drip tape is run through the pipes to water the growing plants.

Figure 4: Climate smart vertical garden

Photo credit: author

As part of the CGIAR's mission to improve food systems, climate resistant and biofortified bean varieties have been developed by collaborations between several different NGOs (HarvestPlus and the Agriculture Research and Development Foundation, both of which have offices at CIAT) and the bean breeding research programs of the CGIAR. Fourteen bean varieties were initially piloted in the Cauca climate smart village. While each variety differed in size, shape, and taste, they all had been developed to resist diseases and pests and to flourish during variable weather patterns. Two of these 14 bean varieties were biofortified with zinc and iron as a response to scientific assessments led primarily by HarvestPlus and collaborations with different universities (primarily Wageningen University in the Netherlands) that indicate that zinc and iron deficiency are widespread among vulnerable populations (interview with Elise Talsma). The biofortified seeds promise to increase or maintain zinc and iron levels when consumed as part of a regular diet.

As José Restrepo (then Director of the Foundation for Agricultural Research and Development headquartered at CIAT) explained to me, the seeds are produced through selective breeding in which seeds with desired traits are selected and bred to produce plants that have the characteristics the researchers have marked as desirable. According to researchers from CIAT, these desired characteristics are both informed by producer opinions and needs and market demands, as beans are understood to be important as subsistence and cash crops. Because the focus of the climate smart village is principally to prepare farmers for adverse weather events, primarily drought and heavy rains, varieties were selected to pilot in Cauca that were adapted to variable levels of rain and to plagues or pests that fluctuate based on climate.

Three producers planted the varieties brought to Cauca as part of a study to determine which beans would adapt best to the microclimate in the Cauca climate smart village and were

most popular among farmers in the region in relation to production and taste. From the initial 14 varieties piloted, farmers and researchers together selected six that the farmers planted again and disseminated throughout their communities through trading or selling seeds. Four of these varieties were climate resistant and two varieties were both climate resistant and biofortified. While not widely implemented, more and more farmers were slowly planting these beans when I finished fieldwork in October 2018.

Figure 5: Carlos Jara and Norma Barbosa check in on the biofortified and climate resistant bean varieties being tested on Alberto's farm

Photo credit: CIAT

As I will discuss in more detail in Chapter Five, the CSAs implemented in the Cauca climate smart village aimed to increase food security by increasing production. Because women had traditionally been in charge of household food procurement and preparation in this region of Cauca, women became the primary beneficiaries of CSAs implemented locally (although men did still receive and work with CSAs). While CCAFS had specific expectations about how and to

what ends CSAs would be used, many local farmers—women farmers in particular—adopted and adapted the CSAs created at an institutional level to better meet their needs.

Often times, for farmers, this process of reconfiguring or adapting the CSAs entailed reflecting on how their parents and grandparents had produced food for their families and communities in the past and carrying some of these lessons into thinking about the future. This marked a significant departure from how CCAFS envisioned CSAs contributing to community futures, which was largely rooted in increasing production to augment income and total foods available. Rather, it was mainly women farmers who employed the CSAs to support food sovereignty and community economies rooted in a politics of caring for themselves, their families, and the environment.

Technological Futures: Science and Technology Studies

In the Cauca climate smart village, CSA is largely synonymous with technology. As a soil scientist at CIAT remarked, "they aren't getting money to fund farmers to *not* turn over their soil," in reference to the idea that CSA is dependent on the development and deployment of agricultural technologies. Theories from science and technology studies (STS) inform my dissertation in analyzing the relationship between technology and social life and provide a framework for understanding how CSAs shape and are shaped by social life in Cauca.

STS is not just limited to examining the social implications of science and technology in the present time, but also aims to understand how technology and science may shape trajectories of a future world in which CSA is an integral part. Sheila Jasanoff and Sang-Hyun Kim (2015) propose a sociotechnical imaginaries framework to understand how science and technologies give rise to social practices, and, in turn, shape the future. Imaginaries, they argue, do not only reflect what is possible through science and technology, but also guide how life should—or should not—be lived in that they are intertwined with visions of a desirable future. A desirable

future, Jasanoff and Kim argue, is often synonymous with modernity as the sociotechnical imaginaries that permeate society are produced by the hegemonic power structures that shape social life.

As climate change grows more dire, researchers such as those at CIAT turn their attention to the possibilities of a future shaped by climate and use scientific practices (for example, climate modeling) to anticipate a future world. Again, STS provides a framework to assess the implications of these anticipatory practices. Moving beyond an analysis of the present-day impacts of climate change on place-based communities that has dominated much of the social science research on climate change (Crate and Nuttall 2009; Orlove et al. 2008; among others), David Hulme (2012) and Kirsten Hastrup (2012) examine how models and scientific predictions of climate, in fact, script societal futures. Hulme analyzes what he refers to as "climate determinism" and "climate reductionism," arguing that climate has become the universal predictor of social organization and, in the context of climate change, the sole predictor of a *future* society under paradigms of scientific modeling of climate (2012). This, in turn, Hulme suggests, has implications for the ways in which we prepare for and realize a future.

Hastrup likewise analyzes how climate modeling shapes relationships between nature and culture and what she calls "practices of anticipation," which in turn guide how futures are anticipated, planned for, and achieved. Anticipation, argues Hastrup, entails both day-to-day forecasting of climate possibilities and a concern with the possibilities of a future world. These daily practices anticipate and transform environmental possibilities into "shared images and expectations that make social action possible." Integral to these imaginaries of possible futures are the technologies developed and deployed that move us toward them, such as those technologies categorized as climate smart.

In the present moment, CSA shapes and is shaped by social life. Scholars of STS have long investigated how technologies are entangled with social life, as technologies create social impacts and are simultaneously "social products" that "embody power relationships and social goals and structures" (Edwards 2007). Integral to understanding technologies, is an analysis of the knowledge systems that produce them. Women's and indigenous peoples' contributions to knowledge production—and specifically to Western scientific thought that guides much policy making and technology production to address climate change—have largely been erased as women and indigenous communities are often viewed as lacking modern subjectivity (Appleton, Fernandez, Hill, and Quiroz 2011; Harding 2011).

While the farmers involved in my research do not identify with any indigenous groups, I suggest that there are parallels between *campesino*[4] and indigenous knowledge systems in Colombia because both are understood as "traditional knowledge." Traditional knowledge has been portrayed as supplemental to scientific thought, rather than as a knowledge system in its own right (Cruikshank 2004). Underpinning the valuing of scientific knowledge over traditional knowledge, feminist STS scholars point out, are debates over who is a "proper" modern subject and, therefore, a legitimate contributor to knowledge (Schnabel and Breitwieser, 2015).

To understand the impacts of technologies, some scholars of have turned to analyzing the social and material consequences of technologies. STS assists in analyzing CSA as it frames the

[4] Campesino translates to "peasant" in English although this translation is inadequate for capturing the nuances of campesino as a cultural and and class-based identity that has been shaped by political realities as much as by methods of earning livelihoods through agriculture. In Colombia, campesino has become a politicized identity by certain groups as they mobilize rural peoples around this identity in negotiations with the government for rights and land protections (Quijano Mejía and Alfonso León 2020). The community members that I spoke with in the climate smart village in Cauca all identified as campesinos. When I asked what this identity signified, they centered most of their answers around foodways and production strategies, proudly describing the iconic *sancocho* dish (a Colombian soup with corn and plantain) that they ate frequently and the long history of ancestral ties to the land. Jimmy Mañunga, as the president of the local governing body, framed advocating for access to rights and resources as part of the broader campesino struggles occurring regionally, nationally, and internationally.

tracing of the "'global' [as it] is collapsed into 'local' social and institutional dynamics" through analyzing how technologies conceived for global dissemination are enacted locally (Brooks 2010; Tsing 2000). A focus on the connections between the global and local provides insight into the assumptions that underpin the development of technologies. This, in turn, has consequences for the reception of technologies such as CSA and their use in local communities.

Feminist scholars in STS have further explored the relationship between technology and social life, analyzing how technologies are mutually constitutive of gendered norms and inequalities (Gonda 2016; Haraway 1988; Harding 1986;Wajcman 2010). Regarding the case of CSA, Noémi Gonda points to the troubling ways that these adaptive technologies reproduce unequal gender relations through discursively constructing women as "victims" of climate change and through reifying traditional gender roles by further entrenching women in domestic spheres (2016). I build upon Gonda's contribution by examining the affective life of CSAs including how women leverage CSAs to build networks of reciprocity and care.

Targeting Women: Development Agendas, CSA, and Care

CSA technologies are also entangled with theories of modernization, progress, and development as they promote technologically advanced agricultural production and market integration. Researchers have analyzed how nations and development organizations often leverage discourses of benevolence and care as they provide communities with resources to "improve" themselves (Dhillon 2017; Carruyo 2008; Murray 2007).

CSA technologies are leveraged as part of a "will to improve" (Murray 2007) in which governments and other development agents are revealed as providing farmers with tools and technologies to assimilate into a modern paradigm of agricultural production. Rather than understanding these exchanges between governments and smallholder farmers as coercion, the will to improve is presented as benevolence, masking the coercive or disciplinary modes of

domination that underpin the improvement schemes. Because addressing gendered inequalities and food security are two of the goals of CSA, women—as the members of the household responsible for food preparation—became the primary target population in the Cauca climate smart village.

Research on gender and development in the agricultural sector has historically focused on questions related to production—including on disparate access to land, resources, decision making, and on differential burdens in labor roles—and how productive inequalities (re)produce gendered systems of oppression (Beuchelt and Badstue 2013). Informed by this body of research, CCAFS aims to use CSA to increase women's decision making, provide equitable access to resources and knowledge, and encourage equitable sharing of labor roles between men and women within households (Huyer et. al 2016). This objective of empowering women is obtained largely through increasing women's economic gains by increasing women's productivity outside of the home.

Despite objections to addressing gendered inequalies through CSA, researchers point to the troubling ways that these adaptive technologies reproduce unequal gender relations through discursively constructing women as "victims" of climate change and through reifying traditional gender roles, limiting women's agency outside of the domestic sphere (Collins 2018; Gonda 2016).While these critiques are valid, they overlook the ways that CSA shapes the intrahousehold power dynamics not related to work roles or production. Rather than understand women's empowerment and agency to be only related to work or economic gains, I borrow from Cornwall, Harrison, and Whitehead's (2007) definition of empowerment as a process of "self-realization, self-actualization, and mobilization to demand change." Although changes in labor roles and economic gains are encompassed by this definition, empowerment is not limited to

these concerns but rather acknowledges how social life and agency are integral to creating conditions for empowerment to occur. Likewise, Gibson-Graham's concept of community economies assists in tracing how local gendered power dynamics shift with the implementation of CSAs beyond measuring productive capacity or monetary gains.

Integral to community economies—an economic model "from below" that emphasizes interconnectivity and interdependence rather than individualistic capital accumulation—are an ethics of care. An ethics of care recognizes that care is a "moral practice, a disposition, a daily need, and a way of living" that acknowledges interconnectedness, dependency, and embodiment as essential to human life (Sevenhuijsen, 2003). Care work, feminist scholars have long noted, is often undervalued, feminized, overlooked, or rendered invisible and intersects with gendered inequalities in that women are oftened burdened most by carework (Gilligan 1982, Martin et. al 2015). Although women are burdened unequally by CSAs in the Cauca climate smart village, women have used and continue to use CSAs to build relationships and a strong food system and, over time, have gained recognition for this work.

Feminist scholars understand care to be tied to affective state, but also to be a practice and as an enactment (Martin et. al 2015, Mol 2002, Puig de la Bellacasa 2011). CSAs were used by women to explicitly care for families and the broader community as they were understood to facilitate the growing of healthy and chemical-free foods that women then prepared for their families and friends. Women also enacted an ethics of care through gifting and trading crops, subverting the aims of CSA to integrate farmers into capitalist markets and instead engaging in noncapitalist exchange. A focus on care work, moving beyond understanding women's empowerment in relationship to productive roles and economic power, illuminates how care is

integral to gendered power dynamics and also essential to the worlds that we construct (Martin et. al 2015).

Critical Agrarian Studies: Theorizing Food Systems and Sustainability

CSA is part of the growth of a "green economy" in which, it is proposed, capitalism and sustainability can work in tandom to address some of the most pressing environmental problems, including securing a future food supply as climate change increasingly makes production more difficult. However, as critics note, as capitalism and sustainability merge, nature and agricultural production are understood and valued in new ways, ultimately leading to the commodification of nature (including lands and seeds central to agricultural production and modified as part of CSA) under this regime of green capitalism (Fairhead et al. 2012). "Dispossession by accumulation" (Harvey 2003), in which public assets become enclosed by private interests, aptly describes CSA as seeds and traditional farming practices are appropriated by research institutions like CIAT and repackaged for capitalist accumulation. Ultimately dispossession by accumulation in the context of CSA remarginalizes farmers rather than empowering them as CSA claims it will accomplish.

These new forms of green commodity dictate how agricultural landscapes should be interacted with by locals as greening production becomes increasingly valuable in global markets. In the case of CSA, agricultural landscapes must see increased production and contribute to future food security through supplying capitalist markets or risk being replaced (Fairhead et al. 2012). Food security research emerged in the 1970s from international development regimes to shed light on the relationship between production, inequalities, and hunger. Solutions to food insecurity are therefore largely focused around short-term technological implementations to decrease food scarcity through increased total production (Hopma 2014; Jarosz 2014, Lewis 2015).

Influenced by calls from food sovereignty activists, researchers working on food security have integrated questions of inequality in hunger through a focus on four pillars: access to and availability, utilization, and stability of food. Despite this expansion of food security as a concept to incorporate how unequal relations of power shape realities of food, food security remains rooted in neoliberal ideologies. As such, it proposes solutions to food insecurity that rely upon increasing production through individual agency, entrepreneurship, and technological advancements—all strategies that CSA relies on in the Cauca climate smart village (Jarosz 2014; Sachs and Patel-Campillo 2014). Food sovereignty, in contrast, seeks to transform food systems as a solution to decreasing food inequalities and achieving food justice.

Food sovereignty calls for a rebuilding of food systems from the bottom up and for centering a right to determine how food is produced and consumed by local communities (Patel 2009). While the concept of food sovereignty is more fluid than that of food security in how it is interpreted and mobilized, it is premised upon several core components. These components include: a right to food, local control over production, valuing local food producers, and environmental sustainability (Sachs 2013). These components were reflected in the ways that farmers in the Cauca climate smart village adopted and adapted CSAs. Rather than focusing on increasing total production, farmers were invested in creating futures that advanced contextually and culturally-specific notions of healthy and sustainable food systems, largely afforded by drawing on the traditions of their parents and grandparents.

Research Focus and Organization of the Dissertation

My research project was developed in collaboration with farmers in the Cauca climate smart village and CCAFS program coordinators and researchers. I sought to conduct research on a topic that was of relevance to both farmers and CCAFS and one that would contribute to local visions for the future. Over the course of my ethnographic and collaborative research, I broadly

investigated the development, dissemination, use, and impacts of CSA technologies and practices at the institutional level (CIAT) and the local level (the climate smart village in Cauca). I detail the complex, and sometimes contradictory, consequences of mobilizing a group of climate change oriented solutions (CSAs) that are rooted in the same structures that, I argue, led to climate change in the first place.

My work will show that CSA perpetuates economic and social control over smallholder farmers and food systems in the Global South while simultaneously being framed as part of caring for and empowering these same communities. CSA permits only certain types of futures to be realized through promoting scientific knowledge and the modernization of the global agricultural sector over traditional knowledge and ways of producing on the land. The closing off of paths to different types of future—specifically, ones imagined by farming communities such as those I worked with in Cauca—then becomes a type of violence for smallholder farmers who are already living marginal existences. Despite the ways that CSA limits community-envisioned futures, my research shows that the implementation of CSA biotechnologies and practices has not been entirely without value for local communities. Rather, farming families in Cauca, and women farmers in particular, are mobilizing these technologies, practices, and the development institutions that create them to push back against the corporatization and technologization of the agricultural sector.

In short, my dissertation takes a two-pronged approach. From an institutional perspective, I analyze why CSAs were developed by institutions like CIAT in Cali, focusing on how CCAFS frames and furthers CSA as a pathway to securing global food security, creating a sustainable future, and empowering women farmers. From CIAT and CCAFS, I then pivot to follow the

CSAs to the fields of Cauca communities where they were implemented, tracking how local farmers appropriated and modified CSAs as they reshaped CSA to better meet local needs.

In Chapter Two, I provide an overview of my methods, focusing on the dynamics of collaborations and participatory research that shaped my research questions and the methods I utilized. I also provide more detailed descriptions of my field sites and identify key informants who appear throughout the remaining chapters.

Ultimately, the contestations around CSA are struggles over the types of futures that might be imagined and constructed by different social actors. In Chapter Three, drawing from Jasanoff and Kim's notion of a sociotechnical imaginary, I analyze how CSA shapes pathways to a certain type of future informed by notions of modernity and by science. The construction of this modern and scientific future through CSA, however, is not totalizing. Rather, I have observed how farmers contested the emergence of this future by using CSA to create pathways to an alternative future that would value tradition and community over scientific progress and capitalist accumulation.

In Chapters Four and Five I examine how CSA aims to transform gendered inequalities and global food systems respectively and what this means for on-the-ground communities in Cauca as related to the activities, technologies, and strategies deployed to reach the goal of facilitating transformation. My research demonstrates that CSA falls short in creating transformations in local food systems and in eliminating gendered disparities because it fails to address structural causes of gender inequalities and disparate experiences of hunger, and instead relies on technological fixes.

Even so, my research also shows that women farmers in the Cauca climate smart village are taking advantage of CSA technologies to challenge gendered power structures and to create

pathways to food sovereignty. Rather than conform to CCAFS' expectation of mobilizing CSA as a means to integrate communities further into capitalist market structures and technologies, farmers in Cauca are creating community networks of care and reciprocity at the center of which are the herbs and vegetables that they grow using CSA. I contend that the ways in which CSA is deployed by farmers in Cauca works to resist the technologization and corporatization of the agricultural sector—that would in the broadest sense burden smallholder farmers with feeding the world while furthering their own economic and social marginalization. Simultaneously, I observed that CSA limits the avenues by which farmers are able to construct their futures by, at times, reproducing gendered inequalities and limiting paths to truly sovereign food production.

Chapter Six sums up the key points in my analysis and draws some broader conclusions. I point to the way that, by framing farmers' current modes of producing and of living as unsustainable and maladaptive, development institutions using CSA (such as CIAT) render invisible their own active participation in contributing to the problems farmers face at a critical moment of rapidly advancing climate change. Because a CSA framework focuses on improvement in the area of food security through increasing production, it ultimately fails to acknowledge and address the systemic and structural reasons behind climate change and inequalities in hunger. Rather it places smallholder farmers, armed with sometimes inadequate technological solutions, on the front lines of addressing a phenomenon to which they largely did not contribute. However, even while CSA presents limitations, we cannot overlook the ingenuity and innovation of local communities as they appropriate and manipulate adaptive technologies to create noncapitalist, equitable, and food sovereign futures.

CHAPTER 2: SITUATING MY RESEARCH: CONTEXT AND COLLABORATIONS

As an anthropologist invested in collaborative approaches to the production of knowledge, I have aimed to use research to contribute to community visions of the future and to leave the tools of anthropology in the communities where I have worked as part of supporting community strategies of liberation (Stuesse 2016). During the course of my fieldwork, I used a variety of qualitative and quantitative methods including: participant observation, semi-structured interviews, a survey on food consumption (24-hour food recall used by nutritionists), participatory workshops, and participatory data visualization activities rooted in a public science approach. In each of these methods, I collaborated with community members, local students, university professors, and professionals from other disciplines and fields in different capacities. With the exception of Jimmy Mañunga (introduced in chapter one and a widely-known public figure), I use pseudonyms to refer to all of the farmers who participated in my research. Likewise, I use pseudonyms to refer to many of the researchers at CIAT who granted me interviews. All of the individuals whose real names I use are easily identifiable through CCAFS' website or other materials published on CSA.

Field Sites: CIAT and Cauca Climate Smart Village

As I mentioned in the Introduction, I conducted research both at CIAT in Cali and in the climate smart village in Cauca, traveling frequently between these sites, except for about four months beginning in February 2018, when I was almost exclusively in Cauca. Anthropologists have pointed to the ways that multi-sited ethnography allows us to analyze flows of people, commodities, and other cultural phenomena across space and place to capture the multifaceted

and complex power structures that shape people's activities, experiences, and resistances in a broader context of global capitalism (DeVault and Gross 2014; Mendez and Wolf 2012). A multi-sited approach attuned to global capitalism and the movement of commodities proves particularly useful in analyzing the effects of climate smart agriculture as a set of technologies, practices, and discourses that originate far from the fields where they are eventually sown. This approach allowed me to follow CSAs from their place of development to their eventual deployment by farmers and to trace the power flows and assumptions that informed the design of CSAs, the ways that they were intended to be used, and their practical application by farmers on their *fincas*.

The Climate Change, Agriculture and Food Security research program (CCAFS) is a research program that leads the development, deployment, testing, and evaluation of CSAs and is central to this dissertation as the primary institution developing and promoting CSAs. CCAFS is headquartered at the International Center for Tropical Agriculture (CIAT) located just outside of Cali, Colombia in the middle of sprawling sugar cane fields and is dedicated to addressing global climate change and food security (https://ccafs.cgiar.org/about-us#.XEjLEs9KjVo).

Figure 6: The International Center for Tropical Agriculture's campus in Palmira, Colombia

Photo credit: CIAT

CCAFS is a research program of the Consultative Group for International Agricultural Research (CGIAR), a consortium of 15 centers throughout the world that conduct research on various agricultural and environmental issues. CCAFS functions as a collaboration across all 15 CGIAR centers in that each center may contribute financially or with other resources to CCAFS. CCAFS often coordinates with other CGIAR research programs because the researchers and staff dedicated to only CCAFS are very limited. For this reason, much of the research that occurs through CCAFS is in coordination with researchers from other programs (for example, the Soils and Landscapes for Sustainability Research Area or the Bean Research Program).

One of these 15 centers of the CGIAR is CIAT, a research institution that for 57 years has worked in the agricultural sector in Colombia and internationally. As the headquarters of CCAFS, CIAT was the institution where much of my ethnographic research took place. I first

began working with CCAFS in 2013 as a visiting researcher after graduating from my M.A. program. Jennifer Twyman, then head of the Gender and Climate Change Team, hired me on the recommendation of a mutual friend I had met during my Master's and I spent a year at CIAT researching and writing under Jen's direction. During this first year at CIAT, I met many of the individuals who appear throughout my dissertation, including those who played a central role in both facilitating and contributing to my research. Deissy Martínez Baron and Ana María Loboguerrero—the Regional Program Leader for CCAFS in Latin America and the Head of Global Policy Research, respectively—welcomed me to CCAFS and to the Cauca climate smart village and lent me their time and guidance on my project throughout the time I worked with CCAFS. Ana María and Deissy were key decision makers in the development of the climate smart villages in Latin America and worked closely with the local partner NGO in Cauca, Fundación Ambiental Ecohabitats Colombia, to decide how to allocate funds and to coordinate research projects.

CCAFS works on multiple scales and many of their activities are undertaken in meetings at governmental ministries where they work to find policy-based solutions with national and regional governments. They also have organized climate smart villages in local farming communities where climate smart agricultural practices and technologies are evaluated in real world situations (as compared to the laboratories or meeting rooms where they are most often developed). The climate smart villages are essentially living laboratories where researchers from both the CGIAR system and from universities, myself included, can propose and implement a research based project that aims to investigate an aspect of agriculture, climate change, and food security in the context of a farming community.

On the surface, the research conducted in climate smart villages aims to engage farming communities through participatory methods so that farmers are embedded in the development process of sustainable farming practices. Therefore, these farmers have a greater stake in implementing practices that avoid contributing to or even help alleviate the effects of climate change. Each climate smart village has undergone a unique process of development based on the relationships between local farmers and regional researchers in the CGIAR and the types of CSAs deployed in the village. For example, the climate smart village in India has been organized around the implementation and testing of a modified rice variety, while the village in Colombia has focused on questions related to food security and the implementation of a climate adaptive home garden.

Because CSA, as understood by the CGIAR, necessitates the coordinating of policies, civil engagement strategies, and development and employment of adaptive technologies, CCAFS researchers work alongside different local, regional, and national organizations and governments. Local partners in particular have a level of control over what activities and adaptive technologies are implemented and how they are implemented in each climate smart village. Ecohabitats, as I mentioned above, was the primary local partner in the Cauca climate smart village where I conducted my research. It was highly influential in determining the focus of the climate smart village in Cauca and the day-to-day programming of activities, as well as the long term organizing of projects and research goals.

Ecohabitats is composed of a husband and wife team, Luis and Liliana. Luis is a dynamic biologist who has been collaborating with communities on ecological projects for years and approaches his work with humor, energy, and, sometimes, little follow through. Liliana is more reserved and grounded and balances out Luis' enthusiasm with careful planning and, as anyone

would acknowledge, is the half of the duo that moves projects forward. They often drove me from Popayán to the meetings that they had organized in the Cauca climate smart village and, as Luis flew down the dusty pot-hole ridden road, shared with me their plans with the communities and the challenges of working with CCAFS. Liliana departed for Guatemala about halfway through my fieldwork to do her own doctoral research and Luis assumed the role of organizer and facilitator of projects, likely feeling overextended by the demands of his multiple roles for Ecohabitats and his family.

My research was conducted at CIAT, mainly in the CCAF offices, and the climate smart village in Cauca, Colombia, the village in Latin America that was most active in testing CSAs.[5] The Cauca climate smart village is located in the northwestern corner of the municipality of Popayán, just outside of Cauca's capital city also called Popayán, where I lived during fieldwork in the region. Although 14 small farming communities (referred to as *veredas*) officially comprise the climate smart village in Cauca, projects headed by CCAFS and Ecohabitats have been mainly carried out in three of the veredas. It is in these four veredas—Los Cerrillos, El Danubio, Las Mercedes, and San Antonio—that I conducted most of my collaborative and ethnographic research with farmers.

[5] As I mentioned in the introduction, the selection of the location of the Colombian climate smart village was partly related to the changing climate. As a consequence of global climate change, average temperatures in Colombia have been steadily rising since 1961, affecting rainfall patterns, diminishing water sources, and creating conditions favorable to agricultural pests. Scientists predict that temperatures will continue to rise, disproportionately affecting agricultural production in the Andes. According to climate change projections, Cauca will be among the most affected departments where changing environmental conditions related to intensifying heat and unpredictable rainfall have already begun to make agricultural production difficult for smallholder farmers (Catarious and Espach 2009; IDEAM 2010).

Figure 7: The Cauca climate smart village

Credit: CCAFS

Los Cerrillos, Las Mercedes, and El Danubio are farming communities located at the end of a pothole-ridden gravel road that winds through the gently rolling Andean mountains only 27 kilometers from Popayán. Despite the proximity to the capital of the department, access to markets and any supplies or goods that may need to be purchased is difficult for many who depend solely on the *chiva*, the daily public bus that leaves from Los Cerrillos around 4 am for Popayán once a week and returns in the evening. In order to reach these communities, I usually caught a small *buseta* in the *Mercado Barrio Bolívar* that, upon leaving the market square, wound its way through traffic to the outskirts of Popayán in the North before turning left down a dirt road that turned to dust during the dry months, coating the inside of the bus. These buses traveled about halfway between Popayán and Los Cerrillos, dropping off passengers along the

way before reaching the final stop in La Tetilla named for the small mountain peak jutting up into the sky.

Once in La Tetilla, there was usually a group of men waiting outside a small store to provide transportation on motorcycles to other communities further down the dirt road. Often when I stepped down from the bus, the owner of the store would already be pushing his motorcycle out of his front door to take me to Los Cerrillos, having spotted me on the bus as it pulled up. I found the inconsistency of public transportation unendingly frustrating as I was often left just before dusk searching for a ride because the bus drivers had arbitrarily decided that their days were finished—instead of making the return trip to Popayán that they had promised me ten or so hours earlier. San Antonio is located much closer to Popayán, a short motorcycle ride down the mountain from La Tetilla. However, people living in San Antonio experience problems of access to transportation similar to the other three veredas where I worked; the walking distance to and from Popayán would take an entire day according to the farmers, who remembered their parents and grandparents making this trip on foot before a road was constructed.

Women in particular rely on the same public transportation that I did to reach the city and, for shorter intra-vereda trips. I often found myself seated next to a woman and her small children wondering out loud when and if the bus would arrive to carry us to the city. If the bus did not show up, I was able to afford an expensive motorcycle ride to the outskirts of Popayán. This, however, was impossible for many of the women trying to make the trip, because of cost or because they were with children, and I can only assume that they returned home and attempted to travel another day. I note this here because access and mobility are two major factors that shape the local food system and women's roles in both feeding their families and participating in community decision making.

Until recently, much of the land that makes up Los Cerrillos, El Danubio, and Las Mercedes belonged to one family. Of the seven children who inherited this land when their father died, one, whom I will call Diego, lives full time in Los Cerrillos working his land and managing that of his siblings who raise livestock or grow small amounts of coffee and sugar cane with the help of hired hands. Diego continues to be one of the most active farmers in the region, seeking out new tools or methods of sustainable production, and has served as the president of several different associations. It was on Diego's sprawling finca situated at the bottom of a mountain that I usually stayed when I was in Los Cerrillos. From his house I would daily climb up the mountain onto the main road that wound down toward the river to visit other farming families.

Just before I began to work in Cauca, the community had undergone a *formalización de predios* (a process to legalize land claims) in which the lands that community members had lived on and farmed for years became their own as claims to the land were legally transferred from Diego's family to individual farmers. As Diego described it, he understood that this land belonged to the community members who had worked it and he felt he had no right to seize land from neighbors and friends even though he had inherited it from his father. The number of times that this story was recounted to me hints at similar formalización processes in other communities that have not gone so smoothly because of the greed of the descedants of large land owners. It also indicates the importance of communal identity in Los Cerrillos, Las Mercedes, and El Danubio.

Nearly all of the women that I visited told me that they remembered how their grandparents had lived down along the banks of the river, sometimes spending hours just climbing up the mountain to reach the road that led to Popayán. While many did not discuss it, through conversations I came to understand that most of their ancestors had been Afro-

Colombians who had worked for Diego's relatives. Race, in fact, was something that was little discussed and only emerged as salient during jokes in which my skin color was pointed out in contrast to a local's. "You will leave here black," Diego said as he laughed, referring to the both the effects of the harsh sun on my skin and the ways that he saw my immersion in a a new cultural context as metaphorically and literally changing me.

However, when I pressed in interviews about how race shaped local life, most community members adamantly denied that race was a factor. Rather, nearly everyone I spoke with identified as campesino rather than Afro-Colombian or Afro-campesino. Only one family I spoke with during my time working in these communities identified, without hesitation, as Afro-campesinos. Despite this ambivalence about how race shaped their lived experiences, in the second summer that I visited Los Cerrillos, the president of the *junta comunal*, Jimmy, told me he was considering having the community declared Afro-Colombian as a strategy of "adapting to climate change." Although I do not believe he pursued this as a strategy to prepare his community for climate change, this reflects the communal claims to Afro-Colombian heritage, which in Cauca is inextricably intertwined with rural life and farming.

Farmers, both men and women, cultivate sugar cane and coffee on small lots (usually just under 2.5 acres). Some farmers may also produce a variety of subsistence crops (plantains, beans, corn) and vegetables and herbs in limited quantities and often use these exclusively for household consumption. While men and women reported on a baseline survey in 2014 that they share a role as co-heads of the household, 65.1% of households surveyed reported that the male head of the household makes decisions about the use of productive resources and about productive activities (for example, when to plant or harvest). Although many women own their

own farm lots, it is not uncommon for men—usually a husband—to make decisions about production on the woman's lot (CCAFS Gender Baseline Survey).

In speaking about labor roles, both men and women participate in coffee production while men generally manage sugar cane cultivation and sometimes call on the "help" of their wives during the sugar cane harvest. Sugar cane, however, requires little daily or weekly maintenance and is not a significant source of labor during much of the year. It is, however, an intensive activity during the harvest. The backbreaking method of harvesting by hand—bending over for hours exposed to the sun with a machete to first cut the sugar cane close to the ground and then skillfully hack off the leaves before tossing the stripped cane into a pile—is also considered men's work because of the perceived intensity level of the harvest. Coffee growing, on the other hand, is considered less intensive, perhaps because of the fact that women participate in cultivation and harvesting. While there is some tree covering in the coffee lots and less hacking than in the harvest of sugar cane, I would hardly suggest that the repetitive bending and straightening and lugging around heavy buckets full of plump, red coffee fruit is easy on the body. Regardless, there is a relatively strict gendered division of labor in terms of on-farm work and productive decision making.

Women exercise significantly more decision making control over the domestic sphere, although not necessarily over resources in the domestic sphere, where men own 50% of the household electronics. However, women are the principal decision makers in the domestic areas of the household, including the home gardens that are often located near the house and are seen as an extension of the kitchen; this is a sphere in which they exercise control over resources and have high decision making power. Women report significant labor burdens in the household,

rising long before and resting long after the men in their households (CCAFS Gender Baseline Survey).

Despite these differences in responsibilities, power, and control, early on in my research both men and women described gender relations in their communities as equal, citing the low level of domestic violence or coercive forms of control over women's bodies, property, and resources as evidence of gender equality. What I hope to illuminate here is that while there is a relatively longstanding community discourse of gender equality, there are significant inequalities in access to power and control and strict gender roles that have implications for how technologies such as CSAs are received and employed by men and women. These gendered dynamics become especially relevant in Chapter Four, where I analyze in depth how CSAs have been leveraged to challenge gender norms and power dynamics.

Situating My Project: Feminist and Activist Research

As CCAFS researchers moved into their third year working in the Cauca climate smart village, they were increasingly interested in measuring the effects of the CSAs locally, largely because of the need to show sizable and scalable impacts to donors funding their projects. I arrived for around this time, when discussions were underway about how to launch a monitoring and evaluation process for all of the climate smart villages to measure the efficacy of the CSA approach. As a result, I was encouraged by CCAFS to do research that would explore the effects of CSA. Deissy Martínez, the Regional Program Coordinator for CCAFS in Latin American, recommended that I explore the topic of food security as related to the implementation of the various CSAs with a special focus on the CSA gardens.

Following an initial meeting with Deissy, I began to organize my dissertation research with the input of Luis and Liliana of Ecohabitats and, especially, in collaboration with Carmen. Carmen was a part-time member of the community of Los Cerrillos as she travelled weekly

between Los Cerrillos and Popayán and maintained a residence in both places. I met Carmen during my first summer of fieldwork in Los Cerrillos when I lived with her family on her husband's finca in Los Cerrillos. Carmen had been interested in food and gardening for decades and large gardens at both of her homes that continued to expand as she became increasingly involved in activities with Ecohabitats and other members of the community. Over the period of my fieldwork, Carmen would become a trusted friend and close collaborator as she planned and ran community workshops with me, collected survey data, and discussed data with me as it was collected. When we went to interviews together, we would often squeeze onto her small motorcycle rather than walk the distance and return to her home loaded down with fruits and vegetables she bought from the women we interviewed.

Figure 8: Carmen

Photo credit: Carmen

I integrated collaborative elements into the development of my project and into data collection in order to focus my efforts on compiling collected data into a narrative that could be mobilized by farmers in the Cauca climate smart village and would contribute to the development of CCAFS' future activities. The questions and methods that informed my project were rooted in feminist and activist principles of research.

Much feminist anthropological writing has focused on themes related to reflexivity and social positionality as the feminist researchers typically lend careful attention to the power dynamics that shape their relationship to their research participants (Babb 2018, Behar and

Gordon 1995; Wolf 1992; Ulysse 2007). Many feminist researchers have reflected extensively on how their own identities—shaped by gender, race, class, etc.—shape the research process with particular attention to how this affects their relationships with and research on individuals and communities that might have less social, economic, or political power than they do (Mukherjee 2017). In this context, feminist researchers in the Global North are concerned with the problems inherent in "speaking for" their research participants (Mohanty 1988; Nagar 2002).

Another body of feminist writing explores questions related to reflexivity and the power dynamics inherent in "studying up" in which building rapport or alliances may not necessarily be a feasible long term goal for the researcher (for example, Mukherjee 2017). I was particularly concerned in interrogating my complicated relationship to CIAT and the ethical implications of this relationship. I was simultaneously positioned as both an insider and outsider (Mullings 1999) because of my long standing relationship with CIAT.

My previous commitments with CIAT created ethical dilemmas related to my positionality and role as a researcher that I have continued to confront during the writing process. On the one hand, I owe much of my doctoral work to CCAFS researchers and coordinators who are well intentioned in the work that they are undertaking in the area of climate adaptation. Admittedly, many researchers at CIAT disclosed that they were disillusioned by the system that they found themselves in within the CGIAR; this was due to the multifaceted limitations they faced in doing their jobs, related to time, funding, and the need to demonstrate quantifiable results. On the other hand, I am critical of CCAFS' program because of the ways that it is burdening farmers through imposing sometimes haphazardly-constructed technologies that require economic inputs and additional labor—and because CSAs place the onus of mitigating climate change on farmers despite the fact that they contribute very little to this phenomenon.

My hope is that my research will provide insights that are useful for CCAFS and other organizations engaged in producing and promoting CSAs and that it can be a starting point for these urgently-needed conversations.

While this legacy of feminist ethnographers was integral to shaping my approach to fieldwork by encouraging me to pay close attention to the power dynamics that informed my relationships with research participants, reflexivity was only a piece of the theoretical framing that shaped my research process. Richa Nagar (2002) reminds us that reflexivity falls short in interrogating the power dynamics of the research process. Rather, Nagar encourages us to take seriously questions of political engagement through thinking about accountability and collaboration in the context of political commitments to the communities we engage in our research (2002).

I reflected on my role in furthering local political agendas over the course of, and following, fieldwork as I relied heavily on decolonizing and activist methodologies (Babb 2018; Harrison 1991; Tuhiwai Smith 1999; Hale and Stephen 2013) that center collaboration in all steps of the research process and on critiques from feminist researchers and activists who challenge researchers to think through the politics of solidarity across social difference (for example, Mohanty 2003). With an aim of decolonizing traditional research methodologies and contributing to community activism, I organized various points of collaboration. I speak about the role of each of my collaborators separately in the following descriptions of the methods that I employed.

However, collaboration does not necessarily result in a more equal process of knowledge production between a researcher and the communities where we conduct research. Christa Craven and Dána Ain Davis (2013) challenge researchers to interrogate the implications of

relying on collaborative strategies to produce knowledge. They point to issues of creating inclusivity and equity through collaborations when certain participants are able to access power, time, and the ability to engage in research more than others that might already be marginalized within their communities (Craven and Davis 2013).

This was certainly the case in my research. I found myself collaborating with women who were already community leaders in their own right and who had been able to access education, technology, and social capital that was inaccessible to other women, particularly those of lower socio-economic status or older women who had experienced limited access to education in their youth. Despite using participatory workshops to try to bring a diversity of voices and opinions into processes of decision-making, my research was largely shaped by my closest collaborators and their visions for the future of the community.

Questions of collaboration, it became clear late in my fieldwork, were also related to expectations about for whom—and for what—scientific knowledge is produced. As I will relate in the next chapter, workshops led by Ecohabitats taught the scientific method to farmers with the hope that they would use these methods of investigation to experiment on their fincas. Although interested in scientific analysis of local problems, farmers generally continued to view scientific studies as a tool of scientists and researchers from outside of their communities. Further, issues of translation and authority about quantitative versus qualitative data implicitly shaped how farmers viewed the utility of research. Quantitative data presented to farmers by other researchers at CIAT—for example, on greenhouse gas emissions or climate projections—is easily identified as directly relevant to farmers' lives because it can be used to directly inform productive choices. The data that I compiled on social life appeared to be less relevant for farmers because it did not provide them with a specific set of recommendations, but rather

sought to engage them in group reflection and dialogue with the aim of facilitating decision-making. An approach rooted in public science, as I outline in more detail in later sections, offers tools to partially alleviate these problems by turning farmers into anthropologists of their own lives and communities.

Methodologies

Qualitative Interviews and Participant Observation

I conducted semi-structured interviews and participant observation at CIAT and in the Cauca climate smart village (Bernard 2011). At the institutional level, the aim of the interviews was to understand the logic behind the development of CSAs, including how and why certain CSAs were selected as related to broader outcomes and impacts the CSAs promised to deliver. With this objective in mind, I interviewed program coordinators, social scientists, and other scientists involved in soil science research and the development of biofortified and climate resistant crops.

More specifically, I interviewed various social science CCAFS researchers and program coordinators who had been involved in the Cauca climate smart village for a number of years in different capacities (from applying baseline surveys to participating in the development and implementation of a monitoring and evaluation survey in February 2018). I interviewed several researchers and a nutritionist working with HarvestPlus, a research program that has been integral to developing the biofortified and climate resistant beans (that are the focus of Chapter Five) alongside bean breeders (two of whom I also interviewed). These interviews gave me insight into activities undertaken in the climate smart villages and questions of how scientific thought informed (or in some cases, did not inform) the selection and undertaking of these activities and CSAs.

Ana María Loboguerrero (the Head of Global Policy Research for CCAFS) and Deissy Martínez-Baron, who were the Regional Program Coordinators for CCAFS in Latin America, along with José Restrepo (FIDAR's executive director located at CIAT) and Andy Jarvis (the Director of the Decision and Policy Analysis Area at CIAT), provided key interviews for understanding the complex factors that influenced institutional decision-making about CSAs. I also spoke with two other researchers, one of whom had previously worked at CIAT and another at CATIE, CCAFS primary collaborator for the climate smart villages in Central America. These interviews provided insights into the logistics of forming the climate smart villages and the dynamics of working with governments to promote CSA.

While interviews provided insight into how CSAs were developed, disseminated, and implemented, participant observation was key for understanding the disjunctures between the intended use of CSAs and the ways that they were put into practice by farmers. I attended numerous meetings and workshops at CIAT and in the Cauca climate smart village where researchers shared research results from studies in the climate smart villages or where various program planning activities and outcomes were shared and discussed. These meetings and workshops permitted me to understand the types of changes that CSAs are anticipated or hoped to create and how broader development indicators and goals (for example, the United Nation's Sustainable Development Goals) influence the objectives of a CSA framework.

In the Cauca climate smart village, I worked in two different sites and conducted two rounds of semi-structured interviews (one round in February 2018 and the other in late June of 2018). During these rounds of interviews I primarily interviewed women farmers. The interviews were focused on experiences of food and food security and gender norms and roles in relation to any changes that the CSAs had facilitated. In August 2018, I conducted three interviews with

men farmers in the climate smart village to gain insight into men's understanding of how gender dynamics had shifted as a result of CSAs. I also conducted one formal semi-structured interview each with Luis and Liliana, although we had continual conversations about CIAT and the Cauca climate smart village that were integral to my research.

One site in the Cauca climate smart village was exclusively in the vereda of San Antonio. The second site was located in Las Mercedes, Los Cerrillos, and El Danubio which are clustered together on the opposite side of the Cauca climate smart village from San Antonio. Because CSAs had not been implemented widely in San Antonio at the beginning of my fieldwork (only three families had CSA gardens), they served as a comparative group to better understand the impacts of CSAs. Community members in Las Mercedes, Los Cerrillos, and El Danubio, on the other hand, had been attending workshops organized by CCAFS and Ecohabitats since the formation of the climate smart village in 2014 and many families had implemented at least one CSA.

In Las Mercedes, Los Cerrillos, and El Danubio, I interviewed 25 women farmers during either one or both rounds of interviews. In San Antonio, I conducted seven semi-structured interviews about gender norms and the food system. Carmen accompanied me to a majority of these interviews and her additional, unscripted questions provided invaluable insight as she nudged the conversation onto topics and areas that did not occur to me as an outsider.

I collected survey data from San Antonio about food consumption patterns, which I address in the following section. Participant observation in Las Mercedes, Los Cerrillos, and El Danubio was centered around participation in workshops with Ecohabitats or group work days to implement a CSA on the farm of a particular family. Farmers were reluctant to invite me to pick

coffee or help with their gardens despite the interest I expressed. In a few cases, I was able to assist for a few hours in the gardens of select women.

Although I conducted few interviews in San Antonio, I became more involved with a group in this community than with farmers in Las Mercedes, Los Cerrillos, and El Danubio who largely performed farm labor separately and only came together to work in a collective for certain projects or activities. In San Antonio, following my initial workshop in the community to explain my project and ask for their participation, approximately 15 families decided to form a weekly work group to construct gardens and to otherwise organize activities to address problems with the local food system. I joined them during the weekly work sessions and supported two young women leaders in particular as they sought resources from various NGO and governmental organizations to provide materials for their gardens and later for cooking courses and a community-managed hen house.

While engaging in activist research with a commitment to reciprocity and a politics of care (Checker 2005; Stuesse 2016; Speed 2006), seems to make common sense, the multiple roles that this stance led me to fill allowed me to understand more fully the visions, needs, and priorities of the communities in the broader Cauca climate smart village. This way, I was able to better create strategies for supporting their priorities and activities. Because of my work in San Antonio in supporting the leadership and project planning of these two women activists, I proposed similar workshops to women in Los Cerrillos, El Danubio, and Las Mercedes to fill gaps in the food system that the group in San Antonio identified. I also worked to assist in organizing knowledge and seed exchanges among women in these various communities as I frequently traveled back and forth between these two areas. I was therefore well positioned to

facilitate an alliance between producers who had not previously been in conversation with one another.

24-Hour Food Recall: A Food Security Survey

A 24-hour food recall method was used to determine changes in food security resulting from the implementation of CSAs. I decided to use this methodology to provide CIAT and community members with a tangible and quantifiable method of determining the changes that CSAs had facilitated in the Cauca climate smart village as related to the local food system. I trained three women farmers in survey data collection and shared with them my research results and my process for organizing and analyzing the data with the aim of demonstrating a simple method for collecting data that could then be used to inform decision-making. After it was compiled and analyzed, these data became central to decision-making processes during participatory workshops. I shared the data in the workshops and we then had a series of discussions about the changes in consumption patterns and the barriers to changing the food system. As a result of these community discussions, my collaborators and I proposed additional community based measures, that the community then approved and undertook, including the development of a seed bank. I organized a series of cooking workshops with a woman from a local organization (SENA) and created a cookbook with the collaboration of a local artist with experience in the food industry to broaden women's knowledge of how to use plants unfamiliar to them (like eggplant or tomatillos) that they had begun to grow in the CSA gardens. Both of these activities were requested by community members and Ecohabitats.

Measuring food security entails understanding the access to and availability, utilization, and stability of food for individuals, households, or communities (Lele et al. 2016: 11). Availability refers to the existence of a reliable source of quality food and is determined by factors related to production, distribution, and exchange. Access relates to the affordability and

allocation of food (including an individual's preferences). Stability refers to the ability to obtain food over time and utilization refers to the ability of a body's needs to be met (based on adequate diet, clean water, sanitation, and health care) (Carletto et al. 2013). Measuring utilization was outside of the scope of my abilities as a cultural anthropologist because it requires assessment of the complex relationships between the human body, health, and food (for example, how parasites or other health problems inhibit nutrient uptake). I instead focused on questions of availability, access, and stability and measured what was being consumed in households with CSAs and without CSAs during different times of the year.

With the guidance of a nutritionist with connections to CIAT, Elise Talsma, I planned a survey that accompanied qualitative interviews and captured what people were eating and when they were eating it. Qualitative interviews illuminated *why* individuals consumed certain foods as opposed to others. The survey, called a 24-hour food recall (Gibson and Ferguson 1999), is commonly used by nutritionists to determine what members of a household are consuming at a given time. In alignment with this methodology, I asked the female head of the household to tell me everything that family members had eaten in the 24 hours prior to the start of the interview, including all ingredients that made up larger dishes (for example, if they had eaten soup, they listed each ingredient in the soup). While most nutritionists ask for portions, I rarely included this question because of my familiarity with what a normal portion looked like in these households from months of eating with different families and because this would have extended the period of the interview beyond a reasonable amount of time. Additionally, I was more interested in how the food system had changed as a result of the CSAs rather than the nutritional intake of individuals.

In addition to asking what was consumed, I asked where each food product came from (whether it was purchased and from whom, or if it was produced on the farm), who prepared the food, and what happened to the food scraps left over. With these additional questions, I was able to analyze the food system more holistically and identify patterns of interest, particularly the question of where food came from (as a proxy of accessibility and also a glimpse of how food sovereignty was shifting). I, along with three local collaborators, visited roughly the same households in February 2018 (before the coffee harvest) and July 2018 (following the coffee harvest); we also visited households with CSA gardens, with traditional gardens (those without the CSA technologies), and without gardens, to collect the 24-hour food consumption survey data.[6] I chose to conduct the 24-hour food consumption surveys before and after the coffee harvest because of a combination of factors related to the climate, seasonal labor, and the local economy.

Before the annual coffee harvest, most families live frugally because the money from the previous year's coffee harvest has nearly all been spent (most families gain a most of their year's income from the harvest between March and late June). However, during this same period of time, and in the months before, there is a relatively light workload, which can free up more time to dedicate to the CSAs. The weather leading up to this period is usually characterized by heavy rains (from October to December of the previous year) and variable rains throughout January. In other words, weather is not favorable to the growth of particularly delicate garden crops and beans. Post-harvest, families receive an influx of money from coffee, but have had limited time

[6] I had planned to also conduct these surveys in August during the dry season. However, it was obvious that community members during this month were feeling overburdened by other research activities and the qualitative interviews that I conducted alongside the 24-hour food recall illuminated that most CSA gardens are mainly planted with only a small amount of herbs during this period. The data that I had received from the first two rounds of the survey was sufficient for drawing conclusions about the relationship between CSAs and food security.

to dedicate to the gardens for the entirety of the harvest as men and women work from sun up to sun down during this time picking coffee. The weather during this period is typically drier with a slightly rainier period during June. The combination of these environmental conditions, labor demands, and economic concerns illuminated when, how, and why families were using CSAs and if CSAs were able to fulfil their promises of providing families with food security (accessible and consistently available healthy food during the entire year).

Elise advised me to interview women because, as she explained, what women eat is usually what the rest of the family eats. However, I found through interviews that women typically ate a much wider variety of vegetables in the Cauca climate smart village than their husbands because their husbands simply did not like the taste of vegetables. Most men preferred to eat starchy foods (rice, plantains) and meat. As a result, I was not able to fully measure how food security has shifted at the household level, but I was able to measure how access and stability (two indicators of food security) to healthy foods have changed. As such, the 24-hour food consumption survey revealed which foods were available during different times of the year.

A Public Science Approach

Central to efforts to decolonize the research process were the workshops planned with Daniel León, a professor at Colegio Mayor in Popayán and a Master's student in Design and Interactive Creation from the Universidad de Caldas in Manizales, Colombia. Daniel was interested in conducting research for his thesis in the Cauca climate smart village on the utility of design methods in facilitating a process of producing, translating, and sharing research results with a community. He originally planned to use the data from the baseline survey conducted by the Gender and Climate Change Team and to focus his efforts on using design to disseminate the results and facilitate "appropriation" and distribution of the results by community members as part of a participatory action research framework (Fals Borda and Rahman 1991). However, by

the time we met in late June 2018, months after Daniel had planned to begin his research, it became clear that a collaboration was desirable for both of us.

Daniel wanted to begin research immediately and I provided a link to communities in the Cauca climate smart village. I was interested in his plans to integrate methodologies and frameworks from the field of design into research and saw an opportunity to deepen the qualitative and quantitative data that I had already collected by placing communities into the position of knowledge producers. Because we used these methodologies late in my fieldwork, they largely served to triangulate the data that I had already collected and to facilitate further community understanding of and engagement with qualitative data about CSAs. These data were then used to inform community action and decision-making.

Daniel and I began fieldwork in early August and conducted three workshops and three interviews with local men. Two of the workeshops were oriented toward data collection and the experimentation of participatory action design methodologies and the third that was related to planning additional activities informed by the results of the first two workshops. The interviews with the men closely followed the interviews I had conducted with women, insofar as they addressed the impacts of CSAs on the local food systems, gender roles and norms, and were used to compare men's perspectives with women's.

The methodological concept that structured our workshops was *apropiación social del conocimiento* ("public science"), which has emerged from the field of participatory action research. Participatory action research centers participants as the producers of knowledge and is distinguished from traditional research methodologies by three attributes. These three attributes include: co-construction and shared ownership of research and research results, community analysis of social problems, and an aim of community mobilization or action (Kemmis and

McTaggart 2014). Public science, likewise, aims to take knowledge production out of the realm of academia and place communities into positions as the creators and managers of knowledge. In other words, public science seeks to democratize knowledge through a process of co-construction and through centering community modes of creating knowledge (Marín Agudelo 2012).

Daniel and I decided on the following activities over the course of two workshops: group response to questions, mind mapping, self-data collection, a collective timeline, and a group brainstorm of solutions. Each of these methodologies used visualization strategies from the field of design in which workshop participants created images or words to answer or respond to a question or prompt provided by Daniel and myself. Mostly women from Los Cerrillos, Las Mercedes, and El Danubio attended the workshops held in Los Cerrillos. Several men from Los Cerrillos and one man and woman from San Antonio attended as well.

For the group response to questions, Daniel and I selected five questions related to experiences with CSAs, gender, and the food system and wrote them on five sheets of paper. Below each question, we drew a straight line and at opposite ends indicated that each corresponded to either less or more in agreement with the question. For example, one question asked, "how much have you participated in decision-making about your farm since the implementation of CSAs?" and below the line ran from "I never participate" to "I always participate." Participants placed a sticker on the part of the line that corresponded to their experience and we had a group discussion about why stickers had or had not been placed in certain areas and why that was significant.

Figure 9: Bárbara, María, and Luisa discuss where to add stickers on the group response to questions activity.

Photo credit: Daniel León

Following this activity, participants created a mind-map related to the CSA gardens. In the center of the map, Daniel and I indicated that the participants should draw a CSA garden and then think about the garden as related to five questions: who, what, when, where, and how. The participants then discussed among themselves what corresponded to each of these questions and included images and words that they decided collectively belonged in each category. As other researchers have noted (Burgess-Allen and Owen-Smith 2010), mind maps can quickly give a broad overview of a topic and provide a basis for a discussion following the mind mapping exercise. In our experience, discussion by participants during the mapping exercise provided a richer set of data to draw from as they discussed among themselves what should or should not be

included and why. The discussion following the mind mapping exercise was more limited in the insights it provided as different community members provided a descriptive interpretation of the map (for example, pointing out what or who was included) rather than explaining why certain choices were made or the logic behind choosing different actors, etc.

Figure 10: Mind-mapping exercise

Photo credit: Daniel León

The self-data collection was perhaps the least successful methodological strategy that we used although it might have the most potential for assessing an area of social life and behavior decided on by the community. Inspired by the Dear Data collaboration between two graphic designers (Lupi and Posavec 2016), this methodology aims to use data collection and visualization strategies to reflect on individual behavior and how it is shaped by and shapes broader social patterns and norms. Once behavior is understood and analyzed, it follows that it can be altered to create change. In the context of our workshop, this method focused on creating data about time spent and work conducted in the CSA gardens over the course of a week. This focus was in

response to claims during qualitative interviews that women spent their only limited "leisure time" in the gardens and that this time was insignificant in structuring their days. As a result, labor in the gardens was not framed as labor, but as part of leisure activities, which, in turn, resulted in an underestimation of women's labor roles on their fincas. This had implications for who was understood to perform work and to contribute meaningfully to the family.

For this data collection method, Daniel and I asked participants to make a note every time they worked in their home gardens during the week between the first and second workshops. Each time participants entered the garden, they were asked to write down the time spent in the garden, the time of day, and any other family members who worked with them. Participants then brought these data to the second workshop and we created a simple visualization of the data. The aim of the visualization was to transform the self-collected data into a representation of the data that was easily understandable and interpretable for all participants in the workshop. Because few participants recorded data on their labor in the CSA gardens, we were not able to compare visualizations from different participants and facilitate a discussion as planned. However, this methodology holds possibilities for creating data on social life that is compiled, analyzed, and interpreted by communities, allowing academic researchers to provide support.

Figure 11: Practicing self-data collection and visualization during Workshop 1

Photo credit: Daniel León

At the end of the second workshop, we used a group timeline activity to facilitate community articulation of a desired future. On a large sheet of paper, we drew a line and, in order from left to right, marked past, present, and future. Workshop participants then drew "positive" elements related to each of these times above the line and "negative" elements below the line. Because the aim of this exercise was to reflect on traditions, behaviors, or strategies used in the past to inform the future, we did not indicate to participants that they needed to focus on one area of work or social life. Daniel and I assisted by asking questions to provoke discussions in filling out the timeline including: "what did your grandparents cultivate and how?," "how will you produce in the future?," and "what works or does not work on your fincas currently?"

Figure 12: Timeline activity

Photo credit: Daniel León

The multiple visualization methodologies we used to analyze the impacts of CSAs led to discussions about a number of problems as related to the local food system that CSAs were unable to address. In order to facilitate community activism and action, we concluded the second workshop with a brainstorm session about both problems and solutions. Participants were given two different colors of post-its and invited to first write down problems. The participants then stuck the post-its on a large sheet of paper and we had a group conversation about these problems, encouraging reflection and inviting opinions from all members of the group. The participants then wrote down solutions on a different color of post-its. We followed this with a discussion and the identification of specific solutions that community members, with our support in logistics, could implement. Our third workshop was dedicated to organizing a seed bank as this was one of the solutions identified as most important in the group brainstorming activity.

Although a public science approach avoids some of the shortcomings of traditional research methodologies by placing communities in the role of knowledge producers, it falls short in other ways by not adequately addressing power dynamics and problems of access and inclusion among community members. As in the case of our workshops, the group dynamics (especially the level of education and related comfort level of different participants) shaped who participated actively and who stood aside to let others speak or draw. This in turn reified already existing marginalizations and served to further silence those who were often not represented in community decision-making. Additionally, complexities arise when trying to convey results from public science methodologies to a broader public. Feminist collaborative methodologies, attuned to the complexities of representation, offer academic researchers the possibility of communicating results to a broader audience as part a politics of solidarity with the communities with whom they work (Nagar 2006).

During the course of fieldwork, I often found myself positioned between CIAT and community members, and gathering data that did not easily translate into the quantifiable language of *outcomes* that would be most legible, and most useful, to CIAT. Likewise, data were difficult to compile into a form that was relevant to community members. I wanted to not simply reflect back to them their lived experiences, but to provide data that were actionable and used to inform community level decision-making or that contributed to community struggles for equality and sovereignty. Although collaborations and a public science approach rooted in participatory action research partially ameliorated these concerns, these methodological tools were largely unable to translate research in a way that would make it both actionable (as related to informing policy or planning for development research) and responsive to local communities. Based on my

experience, I suggest that we, as researchers, need to move beyond placing communities in the role of knowledge producers and assist them in becoming translators of knowledge and decision-makers in their own right, alongside policy makers and researchers.

CHAPTER 3: IMAGINING AGRICULTURAL FUTURES

"Agriculture is behind in digital transformation," asserted Andy to the audience at the CGIAR's Annual Program Review in August 2018. Researchers from all 13 of the CGIAR centers had gathered at CIAT to share research from the past year and to discuss future directions for the CGIAR. Andy was speaking about the potentiality of digital transformation—the process of using the rapidly emerging and constantly changing digital technologies (such as smart phones or digital monitoring systems)—to support and shape the future agricultural sector.

Andy clicked to his next slide where there were four illustrated pictures of what farming landscapes might look like under the digital transformation paradigm. In the vivid and dreamlike illustrations, there were neatly drawn rows of crops being tended to by a variety of machines. Conspicuously absent from these depictions of the future of farming were human farmers. Rather, their labor had been replaced by machines that farmers were perhaps managing from the comfort of some temperature-controlled room at a distance from the fields.

The primary goal of supporting the digital revolution in agriculture, Andy explained, is to support increases in agricultural efficiency and productivity. He continued, arguing for a "refresh" of CIAT's approach to agriculture by developing and disseminating digital tools to farmers. These tools included digital advisory systems, remote sensing systems, and investment in Smart Farming technologies like soil scanning technologies, GPS, and agricultural data management in order to precisely measure and respond to different productive needs.

As I drove back to Cali later that night with a friend from CIAT, we began to discuss our impression of the Annual Program Review. When we got to Andy's presentation, she exclaimed,

"But where were all the farmers?" In Andy's digitized vision of the future of farming, robots would perform most of the drudgery on farms, taking measurements of crop needs and responding precisely to these needs, eliminating the need for human labor. Was this vision of the future of agriculture even farming anymore, we wondered?

In this version of the future, farmers rely on complex and precise technologies and robots to maximize yields and turn away from traditional production strategies as scientific advancements restructure farm-scapes. Although few CCAFS researchers are planning for an entirely robotic farming future, elements of this so-called digital revolution are being integrated into the Cauca climate smart village as part of broader project of modernizing and improving production, simultaneously imposing a scientific and capitalist approach to "smarter" farming. Underpinning CCAFS' approaches to the future of farming are sociotechnical imaginaries (Jasanoff and Kim 2015) in which "collectively held, institutionally stabilized, and publicly performed" visions for the future are understood to be attainable through the development of technologies and the advancement of science.

An imaginaries framework reveals how scientific ideologies and technologies give rise to social practices and ultimately script pathways to certain types of futures. Further, through tracking how sociotechnical imaginaries shape the future, science becomes recognized as an arbitrator of the state of the environment rather than a value-neutral reflection of the reality of the world (Jasanoff and Kim 2015; Seager 2003). However, this work is not a seamless progression from imagination to reality. Alternative imaginaries, Jasanoff and Kim remind us, appear as forms of resistance to dominant sociotechnical imaginaries even as these dominant imaginaries gain traction and persist across place and time.

CSA can be understood as integral to a sociotechnical imaginary in that CSA is leveraged by development organizations as part of modernizing the agricultural sector to ensure a future in which science and technology guide agricultural production and ensure food security globally. Locally, I found that CSA is both adopted and contested by smallholder farmers in the Cauca climate smart village as farmers map out their own visions for the future that center sovereignty, tradition, and a politics of care.

In this chapter, I analyze how CSAs, as adaptive technologies and biotechnologies, construct specific visions of and pathways to a future that smallholder farmers largely become responsible for enacting, despite the ways that this future clashes with their own visions of future-making. I trace the institutional relationships and mechanisms that inform the development, dissemination, and implementation of CSA technologies and practices tacking between local (Cauca) and institutional contexts. I first outline how CSA emerged as a concept, drawing out its connections to the Green Revolution and to discourses of the climate crisis. I then turn to the Cauca climate smart village to explore the deployment of CSAs, focusing on the tensions between scientific and local knowledge in approaching adaptation and the environment. At stake in the use of CSAs is the shape that our global future will take, including who will be responsible for building that future and who will reap the benefits.

The New Green Revolution and the Climate Crisis: Histories of Development and CSA

I am seated across from Deissy in her small office. The noise of the air conditioning humming in the background mixes with the clack of computer keys from the office next door and the general bustle of an office as phones are answered and colleagues chat with one another beyond the closed door. I've just asked Deissy what she thinks about the harsh critiques of climate smart agriculture that highlight its limitations and often propose agroecology as a more sustainable and just alternative. She replied:

> So, I think that there is still a lot unknown about what is being done [in the area of CSA] and they [critics of CSA] are reading various papers [about CSA] that I see as theoretical, or conceptual. But when you go and see how [CSA] is being implemented, it's different. I mean it's distinct because you can't be as radical with one concept or another. Agroecology also doesn't respond to everything. What I have seen is that the papers [critiquing CSA] that are more on the conceptual side, they don't use data, they don't address the discussions that are happening on the ground.
>
> Those of us that are on the side of CSA try to not be closed off to discussion, but we want to look at what the connections are between the different viewpoints. And I think we have been very open in saying, "look, give it the name you want, the point is to produce in a sustainable manner and to improve the livelihoods of the rural population." That's what we are in. To make the climate not be a problem and that all of these soil conservation practices, to make them better so that we can nourish ourselves better. That's what everyone wants. Why do we need to sit down and decide that this is called CSA, that this is called agroecology, and that this is called I don't even know what? Because they are just names and in reality what they are actually *doing* is another thing.

CSA was difficult to define even for Ana María and Deissy who had been part of the development of the concept globally and locally. Despite this difficulty in defining CSA, there were certain characteristics that marked CSA as distinct from other methods of production. Although there were efforts by Deissy and Ana María to engage policy as a central aspect of CSA, technologies were the aspects of CSA that were most heavily relied upon in the climate smart villages to create widespread impact. As Osana Bonilla-Findji, a Science Officer for CCAFS, observed at a meeting with other CCAFS researchers "if we want to tackle inequality and address empowerment, probably an entry point is not technology. But we are entering in with technology."

The turn to technological solutions such as climate smart agriculture is built upon certain assumptions about the future effects of climate change on agriculture. Additionally, it is informed by both a history of technological intervention in the agricultural sector and by the scientific discourses and models that circulate about the anticipated effects of climate change globally. While each climate smart village differs in the CSAs implemented, there are shared

frameworks and objectives that influence the planning within each climate smart village and, subsequently, the development, selection, and implementation of CSAs. As mentioned in the Introduction, CSA aims to increase agricultural productivity, enhance agricultural resiliency, and reduce greenhouse gas emissions from the agricultural sector. CSA encompasses on-farm technologies and practices and national and international civic engagement strategies (Lipper and Zilberman 2018).

In one of the many tours that Liliana and Luis organized to showcase their work, I found myself seated next to a representative of the World Bank who, despite not speaking any Spanish, had been sent to Colombia to meet with CCAFS and to tour the Cauca climate smart village. As we began to talk about climate smart agriculture from the perspective of the World Bank, I asked about how the World Bank had been involved and how CSA had developed there. Over bowls of a traditional Colombian soup, *sancocho*, filled to the brim, he described how CSA came about at the World Bank as researchers were "thinking up solutions for climate change." He said of CSA, "it was simple and it was trying to describe what we were trying to do and what the World Bank was trying to do in terms of transform[ing] agriculture. To *modernize* it."

Climate smart agriculture was first used by FAO in 2010 to call attention to the ways in which the agricultural sector had previously been absent from international policy on climate change. An early conceptualization of climate smart agriculture argued that it was essential to develop and prioritize responses and policy within the agricultural sector, not only because climate change will affect agricultural production, but also because the agricultural sector is one of the primary contributors to global climate change. Despite the widespread attention that the CSA concept has received internationally, the uptake of CSAs by research centers and

governments began before a clear concept and methodology for framing CSAs could be put into place (Lipper and Zilberman 2018).

Because of the history of the development of CSA as a concept, there is no unified understanding of what makes a practice or technology "climate smart." Additionally, as a former researcher at CCAFS' partner organization in Costa Rica—CATIE—pointed out in frustration, there are no clear mechanisms shared among researchers, research centers, and governments about how to develop and disseminate CSAs. I observed that many practices that are labelled as CSA are traditional farming practices that have been appropriated and relabeled (such as using trees around productive lots to protect crops from heavy winds). This is significant because it reflects the commodification and commercialization of traditional farming practices and knowledge for financial gains.

CSA, I argue, can be understood as part of the New Green Revolution[7], intimately tied to the Green Revolution of the 1960s-1990s that restructured the methods and scale of agricultural production globally to modernize the agricultural sector. Although leadership does not position CIAT as part of a new agricultural revolution, an Internet search on CIAT results in titles such as "Q&A: The Man Behind the Next 'Green Revolution?'" (Caldwell 2015). These popular culture articles point to Steve Beebe, the leader of CIAT's Bean Research Program, as forging a pathway toward a new technologically dependent and sustainable productive paradigm at the center of which are his biofortified and climate resistant beans that have already been distributed by CCAFS throughout Latin America.

[7] Although there is little consensus among scholars, researchers, and development workers as to whether we have entered a new phase of the Green Revolution that began in the 1960s, both scholarly and popular culture articles are increasingly discussing the possibilities and pitfalls of a New (or Next) Green Revolution (De Shutter and Vanloqueren 2011: 33-44; FAO n.d.: n.p.; Folger n.d.: n.p; Martin-Guay et al 2018: 767-772; among others).

The Green Revolution was characterized by the proliferation of fertilizers, pesticides, high-yield crop varieties, and large-scale irrigation and mechanizations to increase agricultural productivity with the aim of alleviating world hunger (Basu and Scholten 2013). The emergence of this productive paradigm served to replicate the U.S.'s model of industrialized agriculture in "developing" countries in the Global South, replacing smallholder agricultural models—characterized by the production of local and biodiverse plant breeds—with large-scale monocropping of hybridized varieties managed by commercial pesticides and practices (Holt-Giminez 2017: 47-49). Notably, while the technologies of the Green Revolution did serve to increase the global food supply as related to the total number of calories produced, the Green Revolution did not eliminate global hunger (Patel 2013: 6-10).

With the restructuring of the agricultural sector during the Green Revolution, both smallholder farmers and the environment suffered in certain ways that are relevant to understanding how farmers experience CSA in the contemporary agricultural sector. The Green Revolution forged tight links between philanthropic foundations, private corporations, and national governments in the international agricultural sector. Further, the influence of US-based agricultural models resulted in the replication of neoliberalism as the only viable model for the agricultural sector and for feeding the world (Patel 2013: 41). At a local scale, the Green Revolution served to displace smallholder farmers as they went bankrupt from purchasing the expensive technological inputs promoted widely (hybridized seeds, fertilizers, and pesticides) and catalyzed a loss of traditional seeds and smallholder farmer lands as engineered seeds were planted on a wide scale and as smallholders were pushed off of their lands to make way for monocropping (Holt-Giminez 2017: 48-49).

The New Green Revolution integrates scientific advancements—both productive technologies (i.e. adaptive technologies) and gene technologies (i.e. GMOs and hybridized varieties designed to resist climate change and diseases)—to sustainably intensify agriculture and respond to the perceived urgency of future food scarcity under climate change (Folger n.d.: n.p.; Holt-Gimenez 2017: 48). The hallmark of the New Green Revolution is limiting agricultural inputs (fertilizers, pesticides, etc.) while increasing yields (Folger n.d.). Climate smart agriculture is held up as one of the most promising areas of this new productive paradigm with its emphasis on minimizing agricultural inputs through developing crop varieties and technologies that are resistant to the impacts of climate change while increasing productivity. I expand on this technological reliance of CSA in Chapter Five.

While the New Green Revolution attempts to offer a corrective to the Green Revolution—specifically in terms of addressing the marginalization of smallholder farmers and integrating sustainability—the legacy of the Green Revolution continues to shape the New Green Revolution and limits the ability to restructure the agricultural sector in a way that both prepares farmers for the effects of climate change and lessens the contributions of the agricultural sector to greenhouse gas emissions. The New Green Revolution, similarly to the Green Revolution, furthers the consolidation of neoliberal capitalism in the agricultural sector by displacing farmer knowledge, seeds, lands, and practices for the sake of capitalist accumulation (Basu and Scholten 2013: 2). Rather than climate smart villages being organized as spaces of collective inquiry, the same former CATIE researcher mentioned above referred to them as "laboratories" where already created practices were "tried out" by farmers. The New Green Revolution does not challenge the status quo, but rather inserts itself into already existing neoliberal structures

consolidated under the Green Revolution—which are some of the root causes of farmer vulnerability and climate change in the first place.

Visions and projections of the future likewise shape CSA. As the World Bank representative I met explained, "that's where [CSA's] origins came from… in discussions with governments about planning for…the future." While he was unconcerned with the details of whether a practice or technology might be climate smart or not, he emphasized that CSA is about "the *transformation* that is sought for in sustainable agriculture" (emphasis my own). Scientific narratives about climate change and future food security have been central to shaping contemporary approaches to managing the global agricultural sector and climate governance more broadly.

As former Climate Policy Expert for CCAFS Godefroy Grosjean described during the APR at CIAT in 2018, part of the aim of CSA is to "de-risk" agriculture as it becomes increasingly financially risky in the context of a changing climate. "The tipping point," Godefrey said, "is coming much sooner than expected," highlighting the urgency with which CSA is being mobilized to solve a looming climate crisis. This risk, for CCAFS and the broader community of international development, is not rooted in uncertainty, but rather stems from the climate projections produced through modeling alongside assessments of vulnerability with "climate becom[ing] the one 'known' variable in an otherwise unknowable future" (Hulme 2011). Godfrey, in the same presentation, outlined activities that CCAFS researchers will need to undertake to de-risk agriculture. CCAFS, he said, needs to develop decision-making tools for governments including "profiling climate risk." Profiling climate risk brings together measurements and models of climate-related vulnerabilities with CSA investment plans created for governments and the private sector by CCAFS to address the anticipated risks. This is part of

broader efforts, as Godfrey's co-presenter Evan Girvetz, explained, to "go beyond climate" in addressing climate change by designing financial products.

However, the preparation of financial products is undertaken in reference to measurements of anticipated vulnerability produced by climate change, marking climate as a known in an otherwise unknown future. Likewise, smallholder farmers, I heard various researchers from CCAFS repeat, will suffer from specific risks disproportionately as climate change worsens. These narratives are central to constructing understandings of vulnerability and risk for communities and the global agricultural sector that are then used to frame and address needs at local and global scales. The resulting adaptive tools and technologies, developed and leveraged to address CCAFS' perceptions of specific vulnerabilities and risks, do not necessarily align with local perceptions of present and future vulnerability and need.

Within international development organizations on a global scale, there is a shared understanding that climate change will cause agricultural yields to suffer, which, in turn will affect future food security and reify already existing vulnerabilities shaped by limited access to resources and social exclusions (FAO 2016; Huyer et al. 2016; Lipper et al 2014). According to FAO and CIAT, food production will need to increase by 60% (FAO 2016; Lipper et al. 2014) or, according to the World Bank, by 70% (The World Bank 2011) by 2050 in order to feed the anticipated 9 billion people who will occupy the world. At the same time, research mobilized by these same organizations anticipates that climate change will result in the loss of up to 60% of crops (IPCC 2014; Lipper et al 2014).

Data soundbites such as these statistics above are selectively mined from broader and more holistic studies. For example, the original citation of projected food needs by 2050 is derived from a 154 page document (Alexandratos and Bruinsma 2012) in which the authors

discuss limitations to their methodologies and uncertainty about their conclusions because of the complexity of interdependent factors and the partiality of their knowledge at the time of the study. The authors leave space for uncertainty in future projections in ways that are erased once their conclusions become uncoupled from their study, and thus circulate as within research for development. Notions such as these become the basis for decision-making, despite the partial picture that they present and the unknowable variables that they leave aside.

During my pre-doctoral year at CIAT as a visiting researcher, Andy Jarvis asked the team that I was part of to produce a paper on how climate change would affect men's crops and women's crops using the climate change projections produced at CIAT. Jennifer Twyman, my supervisor at the time, and I were puzzled that we would be asked to do this because crops are never strictly under the control of either men or women (but are rather are the product of complex intra-household work schemes and negotiations) and because there were simply too many unknowable factors about decision making, land and resource access, and political or social dynamics. Our concerns were largely dismissed and we continued to be pushed to produce this paper for several months until Jennifer outright refused. This process of leveraging data selectively for anticipating futures can be understood as part of what Mike Hulme (2011) refers to as "climate reductionism" in which climate is cast as the determining factor in shaping the future, ignoring political, social, and cultural factors that will shape a future world.

Despite acknowledgments by CCAFS that climate projections and climate modeling have limits in predicting future outcomes (Campbell et al. 2016; Vermeulen et al. 2013), climate models have garnered significant authority in their claims to universality and objectivity and are widely deployed to shape decision-making on an institutional level (Hulme 2012; Jónsdóttir 2012). In planning for uncertain futures, climate models remain central in determining climatic

impacts on yields, and therefore, in guiding possible decision-making (Vermeulen et al. 2013). While the complex interplay between goal setting and climate modeling within the CGIAR deserves deeper study, what is relevant to consider is that CCAFS' anticipations of a future world are informed by a scientific understanding of the world that narrowly identifies climate as the main determinant of the future (Hulme 2011).

Climate governance at an international level has also been integral to shaping CCAFS' agendas and goals. Recently, I received an email from Andrea, a young researcher working under Deissy for CCAFS, asking about the link between my research and impacts on a global level. She asked me if I could share any research that could link the impact of CSAs in the Cauca climate smart village to the 2030 Sustainable Development Goals, signaling to me her concern about this set of international goals adopted by the United Nations member states in 2015. These goals, "provide a shared blueprint for peace and prosperity for people and the planet, now and into the future" by urging nations to develop strategies to address inequalities and to preserve the planet (United Nations n.d.). The United Nations' Sustainable Development Goals (SDGs), many of which are built upon the same climate projections mentioned above, have been influential in identifying institutional level objectives within CCAFS, and the "impact pathways" that guide activities undertaken to reach a set of defined objectives. At the 2018 Annual Program Review, frequent reference was made to addressing different SDGs through new directions in research and agenda setting. This signaled how the SDGs act as a frame of reference by which to measure achievement of goals.

Ana Maria, during her talk on transforming food systems, noted that there are already mechanisms in place to contribute to three SDGS—those that aim for "zero hunger," "responsible consumption and production," and "climate action"—and that the integration of

digital technologies holds potential to contribute to others. SDG 13, which concerns "urgent action to combat climate change and its impacts," is particularly important to guiding CCAFS' activities as it deals with actions taken to address climate change (Campbell et al. 2018). A policy note following the 2018 APR explicitly laid out a "theory of change" (the activities and goals) that CCAFS commits to following in order to work toward achieving SDG 13 (Dinesh et al. 2018). Food system actions, asserts CCAFS (Campbell et al. (2018), are crucial to achieving SDG 13.

The SDGs were adopted by the UN at the 2015 United Nations Development Summit as part of the 2030 Agenda for Sustainable development. They include 17 sustainable development goals and 169 "targets" that aim to 'end poverty, fight inequality and injustice, and tackle climate change by 2030' and build upon the eight Millenium Development Goals set in 2000. Despite the good intentions of the SDGs, they risk reducing complex ideas and issues to simplistic narratives and universalizing explanations for the sake of producing easily scalable solutions that can be applied across geopolitical context (de la Rosa Reyes 2017). Although CCAFS, until the end of my fieldwork, had not strictly deployed CSA to address the SDGs and their targets, they acted as a central reference point to measure progress and were important in shaping the agendas and approaches to "Transforming Food Systems" that became an overarching approach guiding CCAFS' activities worldwide.

CSA, I argue, is shaped by a legacy of the Green Revolution and the contemporary approaches to climate governance that reduce climate-related impacts on the agricultural sector from a complex issue that produces and is produced by social life, to one that can be solved through deploying technologies and strategies to increase agricultural production. Projections of the future become highly dependent on climate, limiting visions for the future by imposing a

Western and scientific imaginary of how the future should be realized. Translated into a local context, these sociotechnical imaginaries have consequences for how livelihoods are earned and how communities map out paths to a desired future. More specifically, these institutional dynamics are important to understanding why technologies and practices are designed, legitimated, and disseminated to smallholder farmers, as well as why they sometimes fail to achieve what they have promised once they are deployed in local contexts.

Mapping Out On-Farm Vulnerabilities

"The weather changes all the time," Bárbara told me during our first interview together in the summer of 2015 when I asked about the weather and climate change. "The sun is more intense and hotter and the nights are colder and the days are hotter. Now, at any time [during the year], it rains. Or it doesn't rain when it is supposed to." Farmers in the Cauca climate smart village described the weather in the past as regular and predictable. While farmers were acutely aware of changes in the climate, the ways they framed these changes were shaped by the scientific perspective that CCAFS disseminated alongside technologies and practices.

The region in Cauca where CCAFS implemented the climate smart village was selected, in part, because climate projections showed that these communities would be particularly vulnerable to climate change in the future (meeting with Ecohabitats, 2015). As the climate smart villages developed, understanding and responding to farm-level vulnerability emerged as the first step from which CCAFS' activities grew.

When I arrived in Colombia to begin doctoral research in August 2017, Deissy told me that I should change the focus of my project from understanding local vulnerability to climate change to analyzing the impacts of CSAs because CCAFS had already measured and analyzed vulnerability in Cauca. In other words, Deissy was implying that CCAFS already knew everything that they could possibly know about vulnerability to climate change in Cauca. I did

change my topic to focus on the effects of CSAs on the local food system, but the frequent references to vulnerability by Luis, Ana María, Deissy, and other researchers at CCAFS drew my attention to the ways that different assumptions underpinned their statements about what vulnerability was locally and how it should be addressed. Ana María explained to me how vulnerability had been conceptualized and analyzed:

> But this was interesting because it was [the farmers in the Cauca climate smart village] who identified the climatic events they were the most vulnerable to. If it was hurricanes, if it was hail or if it was, rather, droughts. So there the climate component was really present and they, in [a] participatory exercise, analyzed vulnerability of their own farms and analyzed a question that is very important—that sometimes in climate change [research] is skipped—and it's "what am I vulnerable to?" To really understand what it is that affects my farm.

As Ana María notes, Ecohabitats and CCAFS understood vulnerability to have been defined by the community and to, therefore, accurately reflect lived experiences and realities in the Cauca climate smart village. However, this perception does not account for how trainings organized by Ecohabitats influenced farmer perceptions and understandings of vulnerability. Although local knowledge was integrated into understanding farm-level vulnerability in an attempt to make CSA participatory, it was a cursory integration. Local knowledge, largely in the form of farmer perceptions and observations about the climate, was slotted into a scientific perspective that guided the process of determining and responding to vulnerability.

Concepts serve not only as descriptors of events or phenomena, but as an "ethical imperative or political program" (Bocking 2015) that tell us something about the desired order of the world and the relative value of different knowledge systems. Scientific concepts, in particular, serve to help us understand and act in scripted ways as they separate knowledge from place through claims to universality and standardization. Once the boundaries of scientific concepts have been formed, they travel through and beyond the scientific community to be

imposed by a web of decision-makers (governments, activists, industrialists, etc.) and "become entangled in systems of knowledge and power" (Bocking 2015). Concepts also serve to tell us something about the relative authority of different knowledge systems as a specific understanding of a concept wins out over ways of approaching the same concept.

Certain groups, namely smallholder farmers and women, have been portrayed as most vulnerable to the future effects of climate change in the development literature broadly and in CCAFS Social Inclusion Strategy (Aggarwal 2018; Huyer et al. 2016; Nellemann et al 2011; FAO 2013). These groups therefore become the primary targets of development interventions and, more specifically, the desired users of climate smart technologies and practices, which promise to increase resiliency and decrease vulnerability of these groups (Gonda 2016). In the Cauca climate smart village, following an initial assessment of farm-level vulnerability, women became the targets of various projects to address what was perceived as their unique and disproportionate vulnerability. I address the gendered aspects of vulnerability in the next chapter. Here, I focus on how farm-level vulnerability is constructed within the Cauca climate smart village and the consequences this has for the relative valuing of different knowledge systems (scientific versus traditional) and, eventually, for the adaptive measures selected and promoted.

In order to assess and address vulnerability, Ecohabitats developed a methodology using farm-level maps that relied on GIS data that captured physical characteristics of individual farms. In the Cauca climate smart village, each farmer who chose to implement CSAs was required to sit down with a map created by Ecohabitats using GIS and to identify the "most vulnerable areas" on their farm. Highlighted on each farmer's map were the productive areas of land with thin, colored lines designating different crops (for example, sugar cane, sun-grown or shade-grown coffee, etc.) and the natural and human-made resources on each farm. Particularly in the

early stages of the climate smart village, farmers were enlisted to take quantitative measurements of their lands—including soil quality, local rainfall patterns, and angles of incline on different productive lots—to determine how productive land will be affected by future erosion (from heavy rains) and drought. It was not entirely clear if the quantitative measurements about soil erosion ultimately informed understandings of vulnerability and, eventually, the adaptive technologies implemented. However, it was clear from these activities that farmers were being trained in scientific methods of understanding and addressing vulnerability, despite any shortcomings these methods may have had as related to holistically measuring vulnerability.

With these data, farm-level vulnerability was determined. As Luis continuously noted in meeting with visitors and organizations considering investing in CSA, it is not sufficient to speak about vulnerability to climate change in broad terms. Rather, he explained to each visitor, it is essential for farmers to know "what is vulnerable" on their farms (in reference to areas of the farm, crops, or soils), "how much vulnerability they have" (in terms of impacts of climatic events on productions), and "when they will be vulnerable" (during which events and how their vulnerability will change in the future). The maps focused on which areas of land in and out of production were the most vulnerable to heavy rains, drought, and variable winds as the three primary climate related concerns in the region determined by climate projections.

CCAFS' process of measuring vulnerability drew from both farmer perceptions and scientific assessments of vulnerability. However, farmer perceptions were only integrated into one step of determining vulnerability as farmers were asked to reflect on the climatic events that have affected their farm in the past (winds, rain, etc.). Youth in the communities, like Jimmy's son José Luis, were trained in GIS to be able to create vulnerability maps without the support of

Ecohabitats and mapped vulnerability as related to several geophysical characteristics of land and of climate related impacts.

These slightly more simple maps produced by the youth, John explained to two Australian visitors one day on Diana's porch, captured three aspects of productive vulnerability (drought, heavy winds, and heavy or variable rains) on individual farms. First, a map was produced for each indicator of vulnerability (i.e. drought, wind, and rain) and then the maps were overlaid one of top of the other to identify the most vulnerable places or the places where all three vulnerability indicators overlapped. With these maps, each farmer, John explained, can decide which CSA technologies or practices to implement and where to implement them. The youth are also trained to help farmers calculate how long it would take to implement and adaptive strategy and how much it would cost. Finally, using the same methods to determine initial vulnerability, the youth assisting a particular farmer would measure the change in vulnerability following the implementation of the adaptive strategy or technology.

The maps, through visibly reflecting vulnerable spaces that need to be corrected, mark out a specific path for the construction of a community-wide future and permit the measuring of progress as related to the implementation of modern productive practices and technologies. These maps, and CSA more broadly, Luis said repeatedly during the early years of the climate smart village, were for those "interested in a future," implying that farmers who did not engage in science to manage climate change were not taking the proper steps to ensure a future for their community. Further, this scripted process of measuring and responding to vulnerability was premised upon the notion that farmers were not already addressing any impacts of weather on crop production. Rather than determine the effects of already adopted strategies, a list of CSA technologies and practices was offered to farmers by CCAFS to address relative vulnerability.

Further, this conceptualization of vulnerability was limited to understandings how a few climatic factors affect production.

When I first began fieldwork in Los Cerrillos in 2015, farmers did not identify climate as a primary source of vulnerability. Rather they highlighted the social exclusions that they faced as campesinos and as Afro-Colombians that made it difficult for them to earn a livelihood. Farmers widely commented that their products were seen as "dirty" or "inferior" and they mentioned the discrimination they faced in the cities. They also noted lack of infrastructure in their communities, such as paved roads, that made earning livelihoods difficult. Generally, farmers felt "abandoned" by the government and broader society as they struggled to make ends meet with limited resources and access to governmental services. These concerns, related to structural discrimination, were not integrated into CCAFS understandings of vulnerability that narrowly focused on the projected biophysical effects of climate change on farms. In turn, structural and social inequalities were not addressed in Cauca by CSA.

When pressed to articulate how climate change would affect the community, most men and women explained that men would likely be the most affected because of their responsibilities in planting, managing, and harvesting sugar cane. In most of Colombia, workers harvest sugar cane by hand, moving in a line across the fields as they slice each thick stalk of sugar cane close to the ground with a machete and to then strip the leaves from the top of the cane with practiced machete blows before tossing it onto a pile. Cutting sugar cane is back-breaking work done under full sunlight as the fields provide partial shade only during the very early or late part of the day.

Because of the intensity of the work, I was told by men and women alike, most women in the communities in the Cauca climate smart village do not participate in cutting sugarcane.

Rather, the men of each household often undertake sugarcane harvesting with the assistance of hired laborers who come from households that may not have enough income from coffee harvests to support their families year round. Men, as Bárbara noted, would be disproportionately exposed to the intensifying heat caused by climate change because of their primary roles in working with sugarcane. She made it clear that her job of simply delivering meals to men at midday and staying close to her house during the rest of the day was highly preferable to spending a full day repetitively bending and slashing at sugarcane. This understanding of vulnerability highlights not the geophysical characteristics that would make production difficult, as CCAFS emphasizes in their understandings of vulnerability, but rather the very real and embodied effects of climate change that farmers anticipate.

Despite efforts to measure vulnerability holistically and precisely, social factors that construct vulnerability were largely left aside in favor of physical data. Anthropologists have drawn attention to the failures of a "narrow definition" of vulnerability—that focuses on environmental factors—to capture an adequate understanding of community and individual level vulnerability; such a narrow approach overlooks the ways that social, political, and economic forces, in addition to environmental factors, shape agency and livelihoods (Wisner 2004; Nelson and Finan 2009). Not only does CCAFS' conception of vulnerability overlook important social factors that local farmers understand as an essential aspect of their precarity, but it also reinforces the view that science is superior to local and embodied knowledge.

I am not arguing that scientific assessments of vulnerability cannot be useful to farmers in making decisions on their farms. Rather, I want to draw attention to the ways that scientific notions of vulnerability provide only partial insight into how communities are experiencing climate change and how scientific notions of vulnerability overlap with already existing power

dynamics in multiple ways. In speaking about the so-called "climate refugees," Farbotko and Lazrus (2012) argue that the circulation of narratives about climate refugees entrench communities in inequitable power dynamics, normalizing and naturalizing dominant narratives about climate change that are not universally shared, but rather are context dependent and shaped by cultural frameworks. Likewise, in Cauca, vulnerability to climate change is produced by both climate conditions and webs of power relations; it is not purely a result of climatic events. This scientific conceptualization of vulnerability mobilized to guide program activities in Cauca directly shaped adaptive pathways. This in turn led CCAFS ans Ecohabitats to to propose a limited set of solutions that could not fully address the social aspects of vulnerability experienced by farmers in the Cauca climate smart village.

A "Will to Improve:" Shaping Adaptive Pathways

According to Liliana, "the best way of adapting [to climate change] is to have an adaptation plan." Once a farmer understood the characteristics of how their farm was vulnerable to climate change, as determined by the criteria set by Ecohabitats, they could consult farm vulnerability maps—with the guidance of Luis—and select the CSA practice or technology most appropriate to the anticipated vulnerability. Ana María emphasized that the vulnerability assessments directly shaped the CSAs chosen:

> [In the Cauca climate smart village], this participatory exercise permits the prioritization of the [adaptive] measures. I understand your point in saying that sometimes you look at the gardens and you might say "how is climate relevant?" or maybe "why this?" Yes, the gardens are pretty, but you have to remember that these [adaptive] measures came about from a prioritization [of CSAs] that came from an analysis of vulnerability.

The overall aim of the adaptation plan focused on increasing resiliency of a certain crop (or crops) in the face of a particular (or several) climatic events. Although several practices that were classified as CSAs circulated in the Cauca climate smart village, the CSA garden was the most widespread and heavily promoted within and outside of the Cauca climate smart village.

Other CSAs that were implemented at different frequencies included hybridized biofortified and climate-resistant bean varieties, bio-fertilizers, and planting trees strategically as windbreakers. Since leaving the field, I have heard that biofortified corn varieties have been planted.

CCAFS leadership emphasized that their processes were participatory, suggesting that they avoided some of the pitfalls encountered by organizations that implemented CSAs from a top down perspective. Participatory practices, they also claimed, avoided reifying a capitalist status quo in which big business profited from the labor of smallholder farmers. In response to my question about what she thought about the critiques of CSA reproducing an unequal capitalist system, Ana María emphasized:

> There are a lot of cases, like in the Cauca climate smart village, [in which] the community is benefitting from these [adaptive] measures (CSAs). They are benefitting from thinking about their farms in [the way that CCAFS has taught them]….It might be that CSA, in other places, it might be that they are thinking from a capitalist perspective. This is an example of] CSA being badly implemented.

While some organizations unsuccessfully, or as Ana María says, "badly," implemented CSAs, I contend that even when CCAFS did implement participatory processes, the initiative fell short of the outlined objectives of empowering farmers and dismantling social inequalities. I argue that CCAFS's assumptions about how to prepare farmers for climate change under the CSA paradigm ultimately serve to reproduce global inequalities.

Adaptation, as systematically directed by CCAFS, takes a particular pathway that is underpinned by what Tania Murray Li refers to as the "will to improve" (2007). The will to improve stems from a history of colonization and neocolonization in which nations and development institutions aim to bolster and direct a specific target population's "capacity for action" (Li 2007) for the well-being of global populations. Rather than using direct coercion to create this capacity for action, the will to improve is marked by benevolence, masking the

"coercive, assimilative, or disciplinary modes of domination" through which change is created (Cameron 2012; Li 2007). I watched over a period of five years as the strategic training of farmers in a scientific approach to climate change and adaptation directed farmers to use certain adaptive technologies that were marked as more suitable than other for adapting to climate change. Rather than force farmers to adopt CSAs, CCAFS provided access to scientific knowledge to direct farmer action in ways that did not always align with a particular farmer's understanding of the climate or production.

It was not clear to me, nor to various researchers from CCAFS, exactly how all of the CSAs were selected for implementation. Nadine, an agronomist who had struggled to organize several research projects in Cauca, shared her frustration with me over her inability to understand how the early phases of implementation had unfolded. As a researcher, Nadine was interested in using ethnography to document and analyze the initial decision-making processes in the Cauca climate smart village as different CSAs were presented to farmers and as they decided which ones to implement, where to implement them, and how to implement them. Unfortunately, Ecohabitats, with what Nadine described as an approach to development work that is less focused on analyzing processes and more focused on presenting results, consistently failed to invite CCAFS researchers to meetings. Rather, Luis and Liliana called Nadine following meetings and reported what had been discussed or decided, resulting in Nadine's loss of valuable firsthand data about how decision-making around CSA actually occurred.

I, however, was present in some of these early meetings, which gave me valuable insight into how CSAs were selected. While I could not attend all of the early decision-making meetings because I was in the United States when many occurred, in those that I attended there were clear mechanisms and methods of introducing CSA. Namely, Luis and Liliana relied heavily on

training farmers in a scientific analysis of climate change, adaptation, and production as part of improving farmers' lives and livelihoods in the face of impending climate change. These mechanisms included training farmers to identify what the impending productive challenges would be locally and to use data collection techniques to determine farm-level vulnerability. This, they believed, would directly inform farmers' choice of adaptive strategies.

I attended many of these early workshops during the Summers of 2015 and 2016 when climate-change related concepts were first introduced by Ecohabitats. As Luis explained to me then and many visitors did thereafter, creating a "shared language" that drew from scientific and local knowledge of weather and climate was central to engaging farmers in participatory processes related to CSA. However, he contradictorily explained that shared language was developed by "bringing down scientific language to producers" (*"bajando lenguaje cientifico al productor"*), rather than bringing together local and scientific knowledge as knowledge systems that were equally valid in explaining climate change. Over my five years working periodically in the Cauca climate smart village, I attended workshops in which Luis taught us—farmers and myself—the definitions of key concepts related to the scientific process and climate change including climate change (versus climate variability), vulnerability, adaptation, and investigation (versus "guessing").

As a method of explaining these concepts and to root the concepts in locally salient analogies, Luis often drew on gendered stereotypes. Men, he said repeatedly in workshops and meetings, were like climate change because once they get married, they slowly stop paying attention to and flattering their wives. This change, he told us, was permanent. Climate variability, on the other hand, Luis explained to us, was like a woman. Women would seem to be consistent and steadfast and then one day—like a climate event—would suddenly erupt into

screaming, creating chaos in their paths. Although this explanation unfailingly elicited laughter from community members and visitors, it was all I could do to bite my tongue to keep from criticizing Luis's analogies. I found it very troubling how concepts related to the weather were likely perpetuating the very social norms and inequalities that CCAFS proclaimed that they were dismantling.

After teaching farmers these concepts at workshops, over a period of months, Luis repeatedly quizzed community members, and me, about the definitions of these terms until nearly everyone could repeat word for word the definitions of these core concepts. Training farmers in the concepts related to climate change and vulnerability was particularly important during the early days of the Cauca climate smart village as steps were taken with farmers to measure their relative vulnerability. Accompanying these concepts were investigative tools and methods that Ecohabitats trained farmers in to collect and mobilize on-farm data for decision-making.

Seated with community members in the light green meeting room at the local community center in July 2015, early in the development of the Cauca climate smart village, I listened and scribbled notes as Luis opened a training meeting. He explained that the goal of the day's meeting was to determine "how we are," as related to individual vulnerability. This information, he told us, is already here in the community. Ecohabitats is here only to facilitate the sharing of this knowledge, Luis continued.

The workshop centered around learning how to observe and record scientific data on crops and soils and how to anticipate how crops might be impacted by climate change using these data. Doris, an enthusiastic, middle-aged woman who temporarily worked with Ecohabitats on a series of activities focused on food security, took over the workshop as Luis stepped aside.

She reiterated to our group that the task for the workshop was to determine "how we are" to "make a plan in the face of climate change," marking the link for us between vulnerability and adaptation.

After sharing initial perspectives on the current state of soils and crops as a group, we moved outside to Francis' coffee lot located next to the community center to practice making notes on observations. "[Scientific] observation is key," Doris said. We need to ask "how is the soil? And the water?" She instructed us for the next hour on how to measure the incline of the coffee lot using a bubble level—like what you might use to measure the evenness of a painting hung on a wall—made from a ruler and water bottle. The data about the incline angle of the land could then be used alongside rainfall data collected locally to "help us make decisions [about water]." These measurements, explained Doris, could determine what crops should be planted and where they should be planted, if an irrigation system could and should be used, and the risk of erosion or landslides—all of which CSAs could address. "Knowing about this [water and soil] will help us to make decisions. "

Measuring the incline of different areas of productive land provided just one set of data that farmers were trained, and expected, to collect. I attended workshops in which farmers were trained to measure rainfall, using a rainfall gauge, and to regularly calculate the additional amount of water that crops might need to maximize production. In each of these early workshops, farmers were trained to use tools drawn from Western science to measure different characteristics of soils, water, or crops and to then use these data to inform decision-making about which adaptive measures to implement. In other words, farmers were trained in specific ways to identify their vulnerability and then were offered a set of CSA solutions to implement that corresponded to the ways that vulnerability had been defined and measured.

When I returned to Cauca in 2018, farmers were being trained in the scientific process more explicitly, rather than simply learning how to collect data on different areas of crop productivity. In these workshops, Luis discussed the differences between "guessing" and "investigating." I was again disappointed to hear the use of gendered stereotypes to explain the differences between these concepts. Someone's wife, Luis told us as a way of explaining the scientific approach to investigation, might guess where her husband had been if she suspected that he was having an affair. Guessing, however, was very different from investigating because investigating used *evidence.* In an investigation of her husband's activities, Luis said amid laughter from the participants, a woman might smell his shirt or look in his wallet, collecting evidence about where and with whom he had been.

While these stereotypes were used to elicit laughter and engagement from the both the men and women farmers attending the workshops, they were also used to demonstrate how a systematic investigation—rooted in the collection of specific types of evidence—could be used to strategically inform on-farm decision-making to mitigate the impacts of climate change. Luis gave us as an example in the workshop concerning the weather, in which farmers and Ecohabitats were already using strategies of farmer led investigation to inform productive decisions. For several years, he said approvingly, a few farmers had been using a plastic rain gauge to collect and record daily rain levels on their farms.

Diego, Carmen's husband, was one of these farmers who had collected nearly a decade's worth of rainfall data. Every morning at 7 am Diego checked the rain gauge, carefully marking down the amount of rain that had fallen since the previous morning, before dumping out the accumulated water and returning the rain gauge to its post. Measuring rainfall locally, Diego and Luis told me, gave farmers more precise data to work with than rainfall measurements that were

collected at a regional climate station on the edges of Popayán. Although it was unclear to me if there was a systematic method of analyzing the rainfall data and using it to inform productive decisions, Luis emphasized that data such as these were collected by and for the community and therefore better responded to the needs of local farmers because it was important to farmers to know exactly how much rainfall crops had received for optimal production. These data, Luis explained to me, were in contrast to data provided by "big business." These businesses had an agenda, he observed, that did not necessarily take into account the needs of local farmers, rather they collected and analyzed these data to support the needs of their own corporations.

Although the precise mastery of scientific language explaining climate change and of scientific modes of investigation appeared to be value neutral, objective, or even common sense, this language was ultimately imbued with a worldview rooted in Western scientific thought and entangled in systems of knowledge and power (Bocking 2015). As part of the trainings, non-Western and non-scientific ways of observing and interacting with the environment were replaced with tools and techniques rooted in the scientific method, thereby reframing how farmers understood climate change and the ways that they would be impacted. Traditional and local knowledge was largely framed as secondary to scientific knowledge rather than as a knowledge system in its own right with the authority to assess climate related realities and determine solutions (Cruikshank 2004).

Collecting and organizing local data was understood to be an unequivocally participatory process that prioritized the interests of local farmers over accruing capital. However, this perspective fails to take into account the assumptions and mechanisms that underpin the approach to investigation introduced in the Cauca climate smart village by CCAFS and Ecohabitats. While Luis often referred to this process of bajando lenguaje cientifico ("lowering

scientific language") as a process of "co-constructing a shared language," in effect, I argue that Ecohabitats *imposed* science as a framework to explain local vulnerability and to prepare farmers for anticipated experiences of climate change as part of a "will to improve." Farmers were trained to understand and address climate change through a lens that largely did not account for local understandings of vulnerability and proposed technological solutions, at times haphazardly created, as central to adaptation.

The question of knowledge production is significant because it did not simply inform perceptions of anticipated vulnerability, but also determined the adaptive measures proposed for changes in the social and material fabric of local life and livelihoods. CCAFS' and Ecohabitats' narrow framing of vulnerability ultimately meant that a limited number of technologically dependent CSAs were distributed in Cauca. As Jennifer Twyman, who had been active in the initial phases of the Cauca climate smart village in her role as CIAT's Gender and Climate Change Team Leader, described:

> In the end I don't think there were so many practices available. I don't think that there were researchers in CCAFS that could say that in this site this is the CSA practice or this is the suite of CSA practices that make sense in this site that people should be considering, so I don't think that they [farmers] were ever told "here are some practices that you should consider and you should apply."

Rather than account for differences in context as related to community needs and understandings of vulnerability, easily scalable technologies were turned to by CCAFS to modernize production as part of preparing farmers for climate change. Although some farmers readily took up these technologically advanced CSAs, others modified or refashioned the CSAs offered to them by CCAFS by looking to the past, as I discuss next.

When Science Frustrates: The Dynamics of Local Adaptation

"They don't understand us," Carolina whispered to me during the meeting. "They don't take us into account." It was a cloudy afternoon in June 2015 and Carolina and I were crammed

next to each other on white plastic chairs haphazardly set up outside of the overflowing living room of one of the other farmers in the community named Diana. We were listening to Luis and Liliana explain the newest part of a project organized by Nadine. Luis was encouraging farmers to participate in collecting the data that Nadine wanted, in order to increase the possibility of receiving future subsidies on CSAs—or the ability to participate in any future, and more desirable, projects organized by CCAFS. Carolina's comment was in response to the directions from Nadine that farmers would weigh everything that they produced and consumed from their own farm. This was a monumental task, particularly when few farmers owned scales small enough to weigh anything less than the large burlap sacks that they filled with dried coffee beans and weighed before sending on the bus to Popayán markets. During my years of fieldwork in the Cauca climate smart village, Carolina's sentiments were echoed by other farmers as they frequently led me into their gardens to show me which CSA was not working so that I could share this information directly with CCAFS.

This is not to deny that some farmers happily and successfully implemented CCAFS' CSAs. However, overwhelmingly, CSAs were implemented and then modified to better meet individual needs and understandings of production and the environment. Anthropologists have argued that adaptation must be understood as part of the dynamics *of* societies rather than a change created *by* society through the implementation of a practice or technology (Eriksen et al. 2015). Adaptation is further linked to social relationships—including, I argue, relationships with ancestors—that may be manipulated, pursued, or dispensed with to gain access to resources or help at certain times (Nelson 2007; Puri 2007; Eakin 2006; Crate 2006a; Finan and Nelson 2001; Little et al. 2001; Nuttall 1992; Waddel 1975). In Cauca, women referred to the past as part of constructing and selecting adaptive pathways. Although the productive strategies that they chose

might not be readily identified as adaptive by researchers from CCAFS because they involved reformulating CSA technologies, they have sought to address anticipated or already existing productive difficulties related to the climate.

Less than a year after the CSA gardens were implemented, most women—as the primary caretakers and decision-makers of gardens—began to dismantle them bit by bit, discarding the technologies offered by CCAFS for those that they had used in the past. The CSAs require expensive and technologically advanced inputs in contrast to the modifications and adaptive strategies that women implemented both alongside, within, or independently of CSAs. Many of the modifications to CSAs, or the entirely distinct adaptive strategies women implemented, drew from the experiences of past generations and all offered an alternative to the technologically driven advancements offered by CSA.

In most of the gardens that I visited, women had taken up the drip irrigation system after spending several weeks or months battling the constant clogs in the tubing and had returned to permanently or periodically watering their gardens by hand. The drip irrigation tubes were often piled in the corners of the garden or folded haphazardly outside of the gardens. Many women, annoyed by how ineffective the drip irrigation system was, made a point of explaining to me that it did not work because it clogged constantly and asked me to pass along information to CCAFS so that they could offer a solution. Most women continued to water their gardens by hand as they had done before CSA, sometimes eliciting the help of their husbands or their children.

Several women also tore off the plastic covering their gardens, explaining to me that the plastic magnified the sun and captured heat, burning the delicate plants as they pushed up through the soil, and dried out the land, especially during the hottest and driest parts of the year. Alma was one of the first women to remove the plastic from her garden. When I stayed with

Carmen on her farm, I often stopped by Alma's house to purchase items from her small store that I had forgotten in my apartment in Popayán. Usually we ended up in her garden so that she could show me her neat and well-tended rows of beets, herbs, and Swiss chard, staples that she planted at regular seasonal intervals so that she would always have a stock for her store.

During the rainy season, Alma told me, the plastic over the garden necessitated more labor than she would have performed without the plastic. Rather than rely on rainwater to water the gardens, she had to water her garden by hand. Other women who removed the plastic echoed this reasoning, making it clear that it made more sense to them to leave their gardens unprotected by plastic. While none of the women I spoke with told me that this was annoying or unnecessary, their exasperated tones made it clear that this extra step did not make sense to them.

According to many of the women I spoke with, the plastic covering the gardens was also very expensive and would need to be replaced regularly. During August, when heavy winds tear through the communities in the Cauca climate smart village, many women found that the plastic was easily ripped by intense gusts of wind. Even if not damaged in a high wind event, the plastic would need to be replaced roughly every two years because it would begin to stretch or rip from exposure and would no longer funnel water into the water collection tank. For many, this was a cost that could not be justified because of the problems with heat that the plastic caused. Further, Jimmy's mother Luisa told me, the costly tanks only held enough water to provide irrigation to the gardens for three days and even less if the sun was strong and more water was needed to moisten and cool the soil.

A few women, including Alma among the first, replaced the plastic of the CSA gardens with a thick black netting commonly used in gardens throughout the regions—called a *polisombra*—that they strung between the posts at the four corners of the garden. Alma

explained to me that the netting softened the fall of rainwater and distributed it evenly over the garden, in effect, watering their plants as they would by hand. She went on to explain that the polisombra was something that she had always used in her garden, and she continued to use it even after the CSA garden was established. The polisombra also protected the crops from unpredictable and increasingly frequent hail storms, and provided partial shade to the crops below as protection from intense sun.

When I asked Irene, who lived nearby to Alma, which "adaptive measures" she had implemented, alongside mentioning the CSA garden, she listed all of the herbs and crops that she had planted in her garden. Her neighbor, Carmen, who was present in the same interview, listed the chemical-free fertilizer that she prepared from vermiculture, a practice that she had used long before the arrival of Ecohabitats and their expensive, complex, and labor intensive CSA "biofertilizers." Leading me out to the bed where she kept her worms, she proudly peeled back the plastic that covered her compost, showing me the worms busily at work and how she used a small shovel to mix food scraps into the bed of soil and partially decomposed fruits and vegetables. "I love to work with fertilizer, she said to me, "Look how beautiful it is."

Other women, having been aware since childhood of the utility of different plants in pest control, began to plant *ruda de muerto*, a small-leafed plant with bright orange or dark purple flowers, along the borders of their CSA gardens. Gabriela first pointed ruda de muerto out to me in her garden while I talked with her as she watered her plants. "This is for fumigating" she said, "It's a repellent that you plant in the beds to help control plagues."

A great deal of attention was also lent to which crops were best to grow in association to promote plant health and production. Carmen was particularly adamant about associated planting and discussed at length which plants she grew side-by-side with almost every woman she visited.

A recipe for a sprayable organic pest control also circulated throughout the community although no one could tell me where it came from and for how long it had been used locally; it simply seemed to be a commonsense pesticide that everyone knew about and used in their gardens.

In general, the adaptive strategies that women turned to were rooted in traditional and agroecological approaches to production that are situated as alternatives to industrial agriculture through their attention to biodiversity and creating balanced ecological systems (Altieri et al. 2015). The strategies that were implemented raise questions about the nature of adaptation and what qualifies as adaptation. Women understood adaptation to be the result of observation, experience, and actions that aimed to enact a politics of care rather than to increase crop yields as CCAFS envisioned. Similar to the practices that Naomi Millner (2016) describes as underpinning permaculture in El Salvador, the alternatives to CSA turned to by local women draw on agricultural practices as a "set of embodied archives and infrastructures" in contrast to scientific discourses that situate seeds and plants as independent of their social relations and requiring genetic and scientific intervention. In other words, adaptation for local women was an embodied practice that drew upon and applied both ancestral and experiential knowledge as women intuitively managed their gardens.

A Turn to Tradition to Create the Future

At the end of the last workshop with Daniel, I taped two sheets of paper with a thick, black line stretching down the middle onto the moss green wall in the community center as Daniel began to explain one of our final activities together. "On the sheet," he said, "you see the line down the middle and how it is marked 'grandparents,' 'present,' and 'grandchildren?' Thinking of the community, we are going to draw what corresponds to each of these moments in time. On the part above the line, we are going to draw positive things. On the part below the line, we are going to draw negative things."

Daniel and I stepped back from the paper, making space for the men and women participating in the workshop to begin drawing. Several women grabbed markers, Carmen among them, confidently stepping up to draw something on the paper while others hovered around the edges, either still lacking confidence in their drawing abilities or waiting patiently for others to finish their contributions. I retreated to the corner and slumped into a seat, exhausted and feverish from the cold I had while Daniel urged the participants on, asking them about their drawings while they worked.

Most of the women clustered around the left side of the paper, the side dedicated to the past, animatedly talking as they drew fruits and vegetables that their grandparents used to grow. Other participants, perhaps less confident in their drawing skills, wrote in agricultural practices that their grandparents had used that were no longer very popular within the community, like "cultivating seeds," or ways of producing that were considered more environmentally friendly ("not using chemical fertilizers"). Very few participants focused on the present and the future, even when Daniel pressed them to think more about what they wanted for their grandchildren. At the conclusion of the activity, only a vertical garden and a circular garden—two models of garden that Ecohabitats had first brought to the communities—were drawn as part of the future. The past was vibrant, detailed, and rooted in the embodied knowledge of their ancestors while the future seemed to be largely unimaginable.

Figure 13: Timeline mapping exercise from the workshop with Daniel.

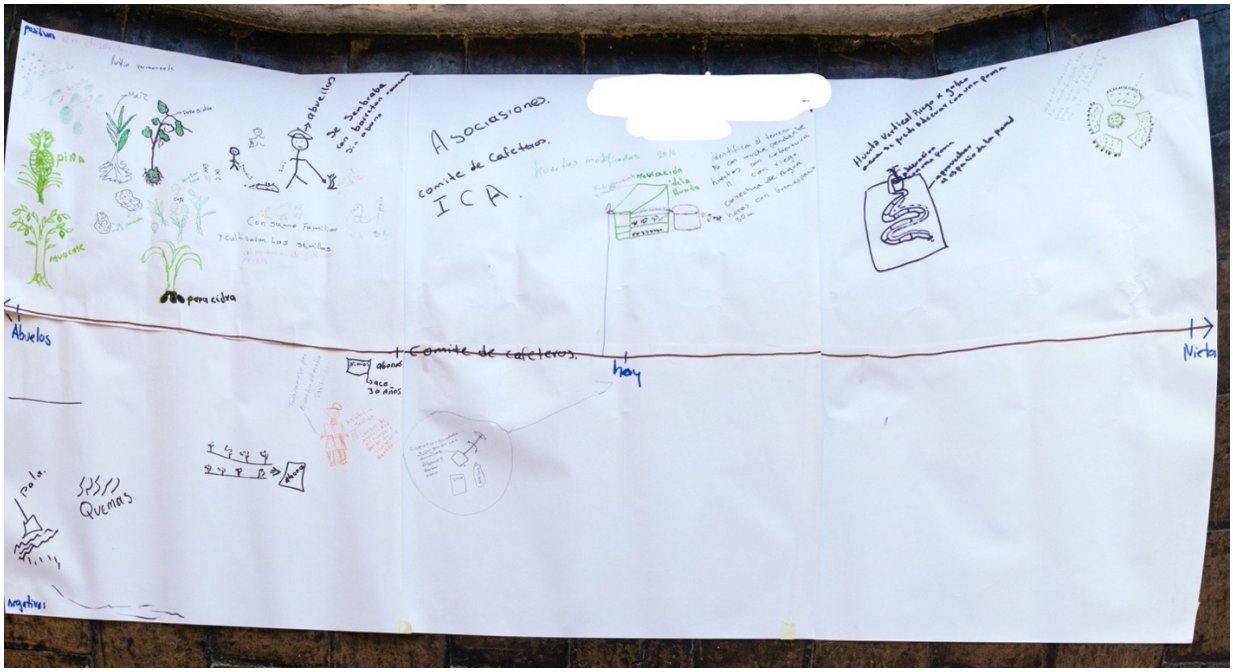

Photo credit: Daniel León

Nevertheless, I argue that this absence of images in the future does not equate to not thinking about or engaging with the future. In both this workshop and in other interviews and instances, community members lamented the loss of traditional growing strategies that they had watched their grandparents use. From time to time, walking down paths cutting through fields, someone would point out a plant to me, noting that their parents and grandparents used to forage for them and saying how shameful it was that they no longer collected food from the land. These images emerged as an alternative to the imaginary of the future promoted by CCAFS that was rooted in notions of modernity and mediated by technologies.

I often heard about how "el otro día," or "in the past," the grandparents of the farmers I spoke with had used other methods of shaping the forest-scapes to provide food for their households. Jimmy described this method of growing food as a "natural garden" and said that it was only in the last ten years that they began to plant the closed gardens that I visited often.

"Imagine that they just used to throw the seeds out [behind their houses] and there they had production!" Lourdes added, "But now, no…" she trailed off as Carmen, Carolina, and Jimmy nodded in agreement. Although there was consensus from the group that wild growing foods were no longer viable because of the widespread use of chemicals to manage weeds and to replenish soils following the burning of fields post-harvest. The community had been slow to recuperate foraging practices as many farmers shifted to organic production.

In the past, the group told us, you could simply walk behind your houses and pluck food from the forest. Although most households still had fruit trees growing in their yards, they had lost crops like cidra and garbanzo that grew semi-wild and often left fruit from the trees on the ground at the base of the tree to rot there. Time and time again, as I visited a farm, the woman head of the household would tell me how wasteful it was to let fruit fall to the ground and rot as they scooped up half a dozen oranges or guavas into a plastic bag and handed them to me to eat later. Slowly, women began to experiment with recipes from their childhood to use the fruit offered to them by the forests. Carmen in particular began making large batches of guava candies and sharing them with friends and neighbors to try to motivate other women to "take advantage of" the yearly abundant harvests. Although I left before the guavas were ripe on the trees, many women had begun planning with Carmen to make different candies to sell in Popayán at a newly organized organic farmer's market.

Sitting around a circle at a meeting organized in Los Cerrillos to introduce Daniel to the community, the twenty or so community members present began to explain to him the work that they had undertaken and why. "This is one of the things that has been a noticeable difference," said Carmen in reference to how the CSA gardens had increased production of crops for food. "Now," she continued, "how do we see…the *after*, the *future*? We will see gardens much more

well-stocked (*surtidas*) and rescuing (*rescatando*) a lot of the products that have been lost. Jimmy already named *cisa* [a type of tuber, as an example of a rescued variety]."

Jimmy spoke over the chatter, as women debated whether Carmen was talking about *cidra*, a type of squash, or *cisa*, a tuber. He said, "but this, for example, we used to eat," referring to cidra and implying that the CSAs had been integral to recuperating lost crops. At my prompting, the group went on to talk about what their grandparents ate that had been lost, listing cidra, *arracacha* (a starchy taproot somewhat like a carrot), and *zapallo* (a type of pumpkin found throughout South America); all were products that households had begun to plant again following the implementation of the CSA garden. For the communities in the Cauca climate smart village, visions of the future were often shaped in reference to the foodways of the past.

The CSA circular garden, as well, was framed as productive knowledge drawn from the past. Carmen told me, as we stepped back together to examine the timeline drawings during Daniel's workshop, that circular gardens had been used by some indigenous communities in the region because of the advantages that circular gardens provided as related to pest control and ease of management. Whether or not this is true, circular gardens were often the topic of conversation in and outside of the Cauca climate smart village because they were understood to be a traditional productive strategy used for many generations regionally and resilient to climate change. The circular garden design was appropriated and relabeled by CCAFS as one of the three models of CSA gardens. This design became a CSA when CCAFS added the plastic roofing, water collection tank, and drip irrigation system that it used in the two other CSA garden models.

However, when women in the Cauca climate smart village spoke of circular gardens, they often were not referring to gardens with the adaptive measures (i.e. the plastic and drip irrigation system) included by CCAFS, but rather to the circular layout of the garden. Carolina was one of

the few farmers who had lovingly implemented a circular garden. On my first visit to her house in 2017, Carolina showed me her new neatly-kept circular garden with beds constructed in concentric circles around a center bed and separated by enough space to allow for movement between the beds. She had cut paths through each bed at different points on the circle to allow for space to walk between the inner and outer circles. The result was a labyrinth-like garden expanding outward from the central bed.

Circular gardens, Carmen pointed out in Carolina's garden, could be planted with pest-repelling plants in the outermost ring, preventing pests and diseases from accumulating in the inner rings where food plants were grown. Lourdes and her husband, in a separate interview nearly a year later on Carolina's front porch, also told me that circular gardens are better because they allow sun to "more directly shine down on plants." These types of gardens, I was later told by local agroecological activists at a meeting supporting the development of a local organic farmers market, also permitted better air circulation and reduced labor demands because the proximity of the beds required less movement by the women tending these gardens.

The few women in the Cauca climate smart village who had circular gardens —Carolina, Gabriela, Mayra and Lourdes—were proud of them, and they and their neighbors frequently commented on how attractive they looked. While CSA gardens were widely critiqued for the failures of their adaptive technologies, circular gardens—because of their unique shape—were understood to encourage plant health and growth without special technologies. Although all of the circular garden owners named above did, at times, use various CSA technologies in their gardens, the circular gardens favored the use of traditional knowledge over the technological advancements.

Traditional knowledge and productive strategies were framed as part of pathways to constructing a sovereign food system and positioned as alternatives to the technologically-driven tools offered by CCAFS. While it is certain that some women readily adopted the technologies associated with CSAs, other women turned to alternatives and engaged in recuperating and building upon ancestral and embodied knowledge. Although the women did not point toward a specific communal future, in the exercise I participated in with Daniel, the past was understood by these women to be integral to finding a pathway forward. This was, at times, in clear tension with the technological advances brought by CCAFS.

CHAPTER 4: WOMEN CULTIVATING SPACES OF EQUALITY, RECIPROCITY, AND CARE

Paula, Carmen, and I were standing with Luisa in her spacious garden in between the raised beds where the tender leaves of cilantro and lettuce were beginning to emerge from the soil. She had been explaining to us all that needed to be done daily to care for the garden and how her husband was slowly becoming more invested in the growth of the crops cultivated in this space. Luisa cackled as she said, "And now I just whisper to [my husband], 'Go, go, go. The cilantro needs watering,' and he goes and does it. He didn't use to do this," Luisa said, dissolving into laughter at her cleverness for convincing her husband to do "women's work."

During the course of my research, I heard similar narratives repeated from multiple women as they commented on how their husbands had become interested in a garden space that was, just a few years earlier, completely unacknowledged by their spouses and neglected for large parts of the year. Feminist researchers working in the area of gender and agricultural technologies have generally framed the relationship between technologies and gendered inequities in relation to how the introduction of technologies shapes productive roles and control of agricultural inputs and outputs by gender (Beuchelt and Badstue 2013). While important to acknowledge, a focus on gains in the area of income, labor, and production overlooks the less tangible components of empowerment, namely the affective realm, which encompasses self-actualization, and the ability to demand change (Cornwall, Harrison and Whitehead 2007).

At the institutional level, I explore how gender inequalities are framed and addressed as CCAFS attempts to both empower women and feed a future world. This, in turn, has

consequences for the possibilities of women's empowerment through CSAs. While CCAFS is concerned with empowering women through the use of CSAs, this concern does not extend to challenging the status quo. Rather, CSAs reify gendered divisions of labor and, subsequently, reproduce the unequal power dynamics that limit women's agency and reinscribe women as relegated to the domestic sphere. Nevertheless, my research illuminates how women themselves push back against these power structures. I watched as women farmers in the Cauca climate smart village used CSAs to challenge local gender inequalities and norms at the household level and to create women-centered networks of care and support.

Gender at the Institutional Level: An Analysis of CCAFS' Gender Inclusion Strategy

Since the formation of the Cauca climate smart village, gender and women's empowerment has been reported by CCAFS to be a central focus. According to Jennifer Twyman, the push to integrate gender concerns likely first emerged because of her participation in the initial steps to organize the site and come up with a work plan and because of the casual observations of Ecohabitats about the importance of integrating a gender lens. Quickly, however, Jennifer observed that the attention to gender became superficial and donor driven as CCAFS confronted greater pressure from donors to show that they were reaching the most marginalized individuals with their adaptive strategies.

A "Gender Strategy" document was first drafted by CCAFS researchers in 2012, in the early stages of the formation of climate smart villages, to outline the aims and goals of all CCAFS climate smart villages and CSA as related to gender. The strategy was revised in 2016 to incorporate other social identities in addition to gender. This revision reflected a clear attempt to integrate intersectionality and address marginalized populations more directly, likely in an attempt to both respond to longstanding critiques from feminist researchers about the problems of superficially integrating social difference into development project and to appeal to more

donors. The 2016 version of the strategy (renamed the "Gender and Social Inclusion Strategy") outlines five hypotheses to facilitate an overarching goal of "creat[ing] opportunities for women, young people and marginalized groups and to promote equitable access to resources, information and power in the agri-food system for men and women to close the gender gap by 2030."

According to the strategy, this goal is achievable through producing research that will support the development and targeting of CSA solutions to vulnerable groups and through increasing the control of these groups over various resources (information and productive inputs) and participation in decision-making at multiple scales. Key to reaching this goal is creating conditions for challenging power relations and catalyzing "gender transformation" at multiple levels, from the local to the global. This is partially achieved by aiming to ensure that climate change interventions do not replicate male-dominated power structures at local and national levels (Huyer et. al 2016: 11-12).

While the attention to intersectional approaches and to a gender transformative agenda reflects thoughtful responses to feminist critiques of the failures of gender and development to meaningfully engage social differences, a closer look at the strategies outlined in the document reveals that there are disjunctures between the theoretical approach outlined and the potentiality of the activities and strategies proposed to fulfill this aim. In other words, CCAFS ultimately fails to outline a path to meaningfully challenge or address the complex and overlapping marginalities, vulnerabilities, and inequalities already existing in the agricultural sector that will become magnified by climate change. This disjuncture between theory and practice is replicated in the climate smart villages. Rhetoric about addressing unequal power structures ultimately become empty words that fall short in facilitating any meaningful change in local experiences as related to the overlapping inequalities structured by gender, class, and race.

Gender transformation, as understood by CCAFS in the Gender and Social Inclusion Strategy, entails "transforming gender roles and relations between women and men, and promoting women's greater equality, responsibilities, status, and access to and control over resources, services and decision-making" in on-the-farm contexts and broader socio-political realms (Huyer et. al 2016: 13). While the authors claim that this approach is contextually rooted, in that local sociocultural norms are taken into account, there is no criterion for assessing what problematic or unequal gender relations gender roles or relationships entail. Rather, local teams, made of researchers largely untrained to conduct social research that takes into account an intersectional perspective are left to determine what aspects of a social system need changing and how they should be changed.

At the heart of a three-pronged approach to addressing social inclusion and gender transformation is the scaling out of CSA which CCAFS claims will increase "women's access to, and control over, productive assets and resources" and women's participation in decision-making (Huyer et. al 2016: 18-19). While there are attempts in this document to integrate an intersectional approach, gender ultimately is understood by the authors to mean "women" as they outline a series of research activities that address only women's experiences and lives rather than addressing overlapping inequalities in the agricultural sector related to other categories of social identity. As a result, addressing inequalities for CCAFS becomes primarily about increasing women's participation in productive spheres, rendering invisible how gender norms, roles, and responsibilities in the spheres of domestic and affective life shapes inequalities and marginalizations and the broader webs of power in which women, as social actors, are located.

Alongside these theoretical limitations, is what one researcher at CIAT characterizes as an increasing turn to the development and deployment of technologies to reduce gender

inequalities. Although during the early stages of the climate smart villages there was a focus on *processes*, this same researcher shared with me that expectations have now shifted to relying on technologies to facilitate a gender transformation. During this same interview, the researcher commented that,

> [at the beginning those working in gender asked themselves] what is the best *process*? We're not going to influence the CSAs and we don't think that CSAs in themselves are going to have a positive or negative effect on gender unless *we* do something. I feel like most CCAFS researchers want to say this CSA will reduce gender inequalities and they don't get that that's never going to happen…. It could have a positive effect or a negative effect or a positive in one place and a negative in another place, right? But let's see, if we can design *processes* around how we disseminate them or share them, then maybe, then maybe they can have the impact we want on gender inequality.

This quote reflects the expectations that achieving gender equality can be catalyzed by the introduction of a particular practice or technology. Rather, this researcher points out that gender transformation can only occur by addressing underlying and structural causes of inequities in the first place. A technology has both the potential to deepen or to alleviate these already existing inequalities if it does not take into account the nexus of power dynamics in which receivers and practitioners of the technology are located.

Coupled with these theoretical issues is the fact that some researchers at CCAFS and Ecohabitats—those that work the closest with communities—are uncertain about the implications of promoting a gender transformative approach for the communities where they work. The fear is that implementing activities to create transformation in gendered power structures could cause community wide conflict and is beyond the scope of CCAFS' responsibilities as a project focused on technological and practical avenues to climate change adaptation. However, this non-interventionist perspective fails to account for the ways that disseminating technologies and knowledge practices to a community will always affect gender relations and gendered inequalities. Technologies and information are not accessed equally by all

members of a community nor are all members of a community able to equally use adaptive strategies or to control the income generated.

These theoretical gaps and issues inevitably shape how on the ground projects in the climate smart villages address and are able to deal with questions related to social inequalities in the agricultural sector. The 2016 Social Inclusion Strategy, despite aiming to holistically address social inequalities through an intersectional perspective, ultimately outlines activities and strategies that only deal with men and women. This narrow framing of gender resulted in the invisibilization of the complex ways that other social differences shape the experiences of individuals and communities in encountering climate change and inequalities in the agricultural sector, and result in a program that may deepen already existing social marginalizations and inequalities.

Framing Gender in the Cauca Climate Smart Village: "Gender Means Family"

As we sped down the road from Popayán to La Calera—one of the communities in the Cauca climate smart village a short drive from Los Cerrillos—Liliana began to talk about her experiences of working with CIAT and the challenges that she continuously encountered. It was early March 2018, just before Liliana departed to do her own doctoral fieldwork in Guatemala and she was scrambling to leave projects in order before her six month absence. With little prompting from me, she began to talk about the disconnect in perspective between CIAT and what community work, in her opinion, should entail as related to the ways that change should be created and how results should be shared. As she described the pressure to create gender related impacts, she told me that she and Luis had received feedback from CIAT that they were not working on gender. In exasperation she exclaimed, "but aren't we working with women and isn't this work in the area of gender!" She continued on, saying that CIAT is "too academic" in their approach to gender, highlighting what she saw as the divide between Ecohabitats as an action-

oriented NGO supporting communities and CIAT as a research institution whose work had little relevance for local farmers.

Jennifer, who had been part of the early work on formulating the plan for the Cauca climate smart village with Luis and Liliana, described to me the process of bringing a gender lens to the implementation of CSAs. She emphasized her initial hope of bringing a critical approach to gender in the Cauca climate smart village through the adaptation plans by carefully considering how processes of disseminating CSAs would affect gender locally:

> So that's where I was hoping to go with local adaptation plans with a gender focus. I don't think it happened, but that was the initial motivation. We talked about the entry point being the family, or the family farm or what have you, and recognizing that men and women do different activities, that they have different access to different resources and assets and all of those things that they participate in different decisions, that they have different power within the household were some of the motivating factors.

Ecohabitats, as the organization that undertook the logistics of planning and implementing CSAs in Cauca, was granted a high level of autonomy in determining how CSA was implemented and, therefore, in defining the concepts guiding CCAFS' research activities. As such, Ecohabitats determined how gender was conceptualized and operationalized and they decided that what they called a "family focus"—or as Carmen said, adopting this perspective, "gender means family,"—was the most appropriate way to address gender. The aim of a family focus, Luis and Liliana told me, was to avoid creating tension between spouses that, in their experience, occurs when men and women are differentially targeted by development projects. In effect, their family focus understood the entire family to be a collaborative decision-making and labor producing unit, and this had the effect of burdening women with additional responsibilities and falling short in achieving the aim of empowering women and transforming gender.

Although there may have been good intentions behind using a family focus to shape pathways for adaptation and to address inequalities within households, this approach is built

upon certain assumptions about gender norms, relations, and responsibilities. In a unitary model of the household, such as the one CCAFS and Ecohabitats employed, all members are either assumed to share preferences or one member of the household is assumed to make all of the decisions in the interest of all household members equally (Twyman 2012: 15). Feminist critiques of the unitary model of household assert that intrahousehold decision-making and resource allocation is much more complex and dependent on gendered norms, relative power status, and resources or assets (include kin and labor related networks, and physical, financial, and individual assets) (Friedemann-Sánchez 2008, Quisumbing and Maluccio 2003, Deere and Doss 2006).

Likewise, in Cauca, a family focus overlooked how access, gender norms, and power shaped adaptive processes and create conditions to further exclude already marginalized individuals within households and the broader community. For example, under the family focus, there was little consideration to who selects and why they select certain adaptive technologies and to who performs labor associated with the adaptive strategy and controls any resulting income. Rather, families were encouraged or assumed to make decisions together in a way that contributed to the well-being of all family members. There was little discussion of who would be most burdened by a particular technology and what collaboration should look like within a household and how work related to CSAs might be approached equitably.

In general, the institutional conceptualization of gender as a family focus rendered invisible the complex power structures that shape intrahousehold life and pathways to adaptation. A family focus also had implications for how inequalities were understood and how programs and projects were formed as a corrective to these perceived inequalities and injustices. Women's

paths to empowerment, as part of a broader narrative of gender transformation, was one such area that I analyze in the following section.

Targeting Women: Increasing Women's Empowerment Through Economic Gains

As the men finished mixing the ton of organic fertilizer that we had just made for Camila's enormous, recently constructed greenhouse, Liliana called the women over to the side and began to distribute calendars. I stood on the edge of the cluster that formed in front of Liliana as she began to explain the intent of the calendars. For months, Liliana and Carmen had been trying to organize women into a group to market their crops from the CSA gardens in Popayán with little success. While there was some interest on the part of the women who showed up to the marketing group meetings in creating connections to buyers, the women consistently failed to plant their gardens in a way that would result in a steady supply of different crops and herbs. Without a consistent supply, it was impossible to secure a contract with a buyer.

After considering different reasons for the lack of consistant planting, Liliana and Carmen decided that it might be the result of disorganization and had brought the calendars to the group with the hopes that this would resolve the problem. The plan was to mark the date on the calendar when each member of the group should have a particular crop ready to take to market and then work backwards in time, marking dates for all of the tasks that would have to be completed before the harvest. Then, all the women would have to do would be to follow the tasks on the calendar and they would be able to successfully work together as a group to take their crops to market. As far as I know, no one used the calendars.

Nested within a focus on the family, and likely because of expectations from donors to address gender in project outcomes, CCAFS and Ecohabitats created initiatives, like the one described above, that targeted women to achieve women's empowerment. While these initiatives did not address gender as a system of power, they did bring limited attention to the differences

between men and women as related to labor roles and control of income. Jennifer explained why she thought that production became an entry point for addressing gender:

> I think that the one that's easiest to grasp is around the gender division of labor and that women tend to do these things and that men tend to do these things and let's recognize all the work that men and women do in the household, especially related to agriculture, and so, as we were developing adaptation plans that became an easy entry point and actually something that they [Luis and Liliana] felt like could be addressed...

This selective choice of when and where to bring in social difference had implications for how paths to women's empowerment were constructed and how women encountered CSA as a solution offered to address social vulnerabilities furthered within a context of climate change.

These initiatives were built largely on the assumption that targeting women in agriculture will first increase women's productivity, and that increases in women's productivity will then produce benefits specifically for women. These casual links are taken as valid by donors and, as such, there is an ever increasing push by funders to require that gender be addressed in proposals and projects (Doss 2018: 36). Donors, according to Jennifer, had influence in bringing attention to gender in the climate smart village by putting pressure on CCAFS and Ecohabitats to demonstrate that CSA was a scalable tool that would address women's marginalization in the agricultural sector. However, it was not only donors that were influencing how gender was conceptualized and operationalized. Ecohabitats and CCAFS operated under the same logic that increases in women's productivity would bring multifaceted benefits directly to women, specifically financial gains, which would lead to women's empowerment.

The development of the climate smart home gardens as a source of income for women (and, according to the causal logic outline above, a key step toward women's empowerment) was the most clear expression of the contradictions between a family focus and the targeting of women. The CSA gardens were explained to visitors and the farmers within the climate smart

village as a crucial step for family food security. Once the family had consumed all that they needed from the gardens, women were encouraged to sell surplus crops and herbs. Months were spent meeting with the women with CSA gardens to try to develop various mechanisms to ensure steady surplus production on the part of women and to develop a consistent market with clients in Popayán.

This new source of income, CCAFS assumed, would lead to increases in women's decision-making and their access to and control over additional resources and income. What this initiative failed to account for, and one of the reasons why I suggest that women were not more motivated to participate in the organization of a steady market, was that many women already had an independent source of income from their coffee lots. Selling crops from the garden would add minimally to women's total income and the profits would likely be used to care for their families. In other words, the additional income from the gardens would not necessarily empower women through providing them with the opportunity to acquire resources that benefitted themselves, but would rather reify women's role as the family caregiver.

As in many development projects, empowerment and gender transformation in the context of the climate smart villages have been simplified from complex processes of "self-realization, self-actualization, and mobilization to demand change" (Cornwall, Harrison and Whitehead 2007) to initiatives organized around transferring information or providing women with opportunities for financial gain. Rather than acknowledging and addressing the structural reasons for women's disparate control over land, resources, and access to knowledge locally, CCAFS rather looked to increasing women's productivity and economic gains as a means by which to empower women. This approach further failed to address how women's differential

access to resources, knowledge, and decision-making equate to women's disparate levels of vulnerability to climate change when compared to men (Huyer et al. 2015; Gonda 2016).

Although women were distinctly targeted in the CSA garden intervention, the overarching family focus obscured the ways that individuals contributed differently to the financial functioning of the household and the day to day practices of care required to maintain a family and a garden. By shying away from initiatives, activities, and conversations that challenged the gendered status quo, CCAFS inadvertently reproduced the very power structures that they understand as creating women's greater vulnerability to climate change when compared to men's. Women farmers participating in the climate smart village are simultaneously overlooked and overburdened by the initiatives implemented in the Cauca climate smart village as CCAFS seeks to empower women through a family focus that obscures women's distinct roles, responsibilities, and the power dynamics in which they are located.

Women's Leveraging of CSAs in the Cauca Climate Smart Village

Carmen and I were seated on the front porch of her house late one afternoon in June drinking coffee and eating homemade *arepas* while I shared what I had learned in some of the interviews in the past few days during a stint of busy fieldwork in Los Cerrillos. We were discussing how many women had told me about the transformation in their husbands' attitudes following the implementation of the CSA gardens when Carmen brought up Jimmy's mom, Luisa. Carmen had recently seen Luisa when she dropped cheese off at her small store across from the community center in Los Cerrillos and Carmen recounted what Luisa had told her when they went to see her garden. Luisa, Carmen told me, had said to her that, "now it was her husband that loves the garden" and that she had found him watering the garden the previous Sunday of his own accord. "So," concluded Carmen, "this is what unites the family."

In alignment with feminist critiques of development and technologies, researchers have critiqued CSA for reproducing unequal gender relations (Collins 2018; Gonda 2016). While my research demonstrates that in certain ways gender inequalities are reified by the implementation of CSAs, I argue that this perspective falls short of capturing the complexities of the relationship between technologies and gendered power systems by focusing narrowly on the realm of production. My research reveals how these technologies are intertwined with domestic life and shape intimate and affective relationships. Despite the ways that the institutional framing of gender reproduced or failed to address unequal gender dynamics, women in the Cauca climate smart village took advantage of CCAFS program initiatives and activities in ways that allowed them to challenge certain aspects of gendered power structures.

Women Work and Men "Help:" Gendered Labor Roles in Maintaining CSAs

Women, as I noted in the Introduction, had traditionally been in charge of small gardens before CCAFS designed and financed their climate adapted versions. These gardens were small and usually maintained only during the parts of year when the right amount of rainfall did not damage the crops from either drought or heavy rains. On my first visit to Los Cerrillos, Las Mercedes, and El Danubio in 2014, I saw numerous small gardens in various states of neglect because, as women told me, it was simply too time consuming and exhausting to haul water by themselves once or twice a day to keep their plants from dying. Some women sheepishly joked during my first visit about the irony of farmers having to travel several hours to town to purchase food when they had the land and knowledge to produce it themselves. However, without the labor and support of their families and partners, it was impractical to attempt to maintain a garden during most of the year.

Most women who had implemented the CSA gardens echoed the words of Luisa at the beginning of this chapter, commenting on how they had slowly involved their husbands in caring

for gardens or, in the case of a few women, had entirely passed the gardens off to their husbands. Although various technological aspects of the CSA gardens failed to work correctly, leading women to discard these technologies in frustration, it was the presence of technologies that allowed women to solicit the participation of men in the first place. As Jorge explained to Daniel and me:

> The garden, more than anything, has to be [done] together, right? My wife and I—because you know that women, not to underestimate them, because they also can—but it's a question of infrastructure and transporting the material. This is always going to need both [men and women]. The husband handles all of the infrastructure and the wife handles the plants, the beans, and all of that stuff.

Men, without question, were responsible for both the implementation and maintenance of the bamboo structure that covered the gardens and for situating the large water tanks where they would feed the drip irrigation system. Women told me that they shouldered the bulk of the responsibility of day to day maintenance and reported being responsible for tasks such as planting, watering, weeding, harvesting, and controlling pests and plagues. Although many women agreed during the workshop I held with Daniel in Los Cerrillos that they now worked more, they felt "satisfied by this work," simultaneously implying that it felt less arduous than other labors that they had to perform.

In interviews, when I asked how much time was spent taking care of the gardens, most women told me that they were unsure because they went to the gardens in their free time, in turn emphasizing that working in the garden no longer felt like labor, but a leisure activity. Juliana described a shift in how she saw her garden after the CSA technologies were implemented:

> I was one of the people that, how do I say, liked to garden, but I didn't give it the love and attention [that I do now] because it made me cranky. I used to say, 'ay no!' Being there on that land, the land the dried up in the summer and damaged [all the crops], that made me feel unmotivated and I said, 'I'm not going to bother with this anymore.' But now, it is different. I mean I like [gardening] a lot and I was one of those people that almost never did.

Like Juliana, many other women viewed working in their garden as what Carmen repeatedly described as a love for the plants and because of the potential of these spaces to feed and nurture their families. As Yesenia told me on my first visit to her house, "With [the garden] I sustain myself, I sustain my family."

Because the CSAs most widely implemented in the Cauca climate smart village aimed to increase food security, women shouldered the greatest burden as those responsible for feeding their families. Women's labor in this space was not always acknowledged as *work*, as Yesenia's quote above implies. Rather, their labors were framed as care and, therefore, as natural and an "act of love" (Poster et al. 2016). This "invisible labor" (Poster et al. 2016) resulted in an undervaluing or lack of acknowledgement of their labor by their families and themselves even as many women told me that they worked much longer hours than their husbands.

Despite women's unequal labor burden in maintaining this climate smart practice, key moments of collaboration were forged by the implementation of this adaptive strategy and had implications for power structures within the household. Women strategically drew their entire families into the process of caring for the CSA garden, beginning with asking for support with the technologies implemented and eventually eliciting the help of their families in the day to day maintenance. Their husbands, in particular, were expected to help with both technological implementations and daily tasks. However, men's work in the gardens was framed as *help*, highlighting the role of women as the primary organizers and caretakers of these spaces.

Women frequently mentioned to me that they were the organizational force behind the implementation and maintenance of the climate smart practices aimed at increasing food security (the gardens and hybridized beans), noting frequently that their husbands did not take the initiative to implement or plan for the care of the practices. Celia, thinking out loud during our

interview as she picked coffee, told me that, "right now anything that gets done is because of me, but [my sons and partner] are almost at the point of taking the initiative [to get things done]." When I asked her about why she thought that she was the organizational force in the household, she paused from picking coffee and thought for a moment. "Well, I think I would say that they [her sons and partner] haven't learned to organize their time like I have because of house work," she said. "Maybe this," she continued, "is the only thing that keeps them from taking the initiative [with CSAs]." Other women echoed this sentiment, noting directly or indirectly that they were the ones to draw their families into care of the CSAs.

Despite the secondary role in which men were engaged as helpers to their wives, their entrance into spaces previously conceptualized as unworthy of time and attention was a significant departure from typical gender roles. Helping in the gardens, in some cases, was the first step toward men's participation in other areas of domestic work. Seated on Carolina's front porch with her husband, Santiago, and her sister, Lourdes, and Lourdes' husband Carlos, they described to us the changes that their relationships had undergone since implementing CSAs. Carolina explained:

> Well before…[my husband] mostly worked on what was related to farm production and I was here in the house. But after the trainings, we both redistributed our [labor] roles and [now] we work together. He arrives at the house after working and, for example, helps with washing clothes…

Her husband chimed in, "Yes…and at home on Saturdays and Sundays, [Carolina] Makes lunch and I do the cleaning in the morning." He finished, "You have to help hanging up clothes or folding clothes…" as his brother-in-law, Lourdes' husband, added "and sweeping and wiping down tables." Although not widespread, some men began to prepare meals and contribute to childcare, especially if taking over these responsibilities periodically freed up their wives to

attend Ecohabitats' and CCAFS' meetings for different initiatives related to the climate smart village.

While hybridized, biofortified beans were planted less frequently and required less care, these generally fell to women who only called on the help of their husbands to complete certain tasks such as clearing the land or, in rare cases, spraying the beans with pesticides or herbicides. When I asked a young researcher, Norma Barbosa, from CIAT's bean group who was most responsible for CSA beans, she responded that women were. "In the case of Mateo (one of the three farmers who planted the CSA beans first in Las Mercedes), when he neglected the crop, his wife was the one who got the project off the ground," she told me. "And she was always there when we went [to check up on the beans]." This, she explained to me was common in Colombia because men usually work away from their homes. "Women," she concluded, "are always more attentive."

While men's engagement in labor roles different from their traditional ones followed the implementation of these low value CSAs, women's roles on the farm largely did not change. Because the adaptive strategies most heavily promoted were created to increase family food security, women's traditional work roles intensified. Unlike men, women told me that they did not begin to participate in different types of jobs, including those that were traditionally framed as men's work, following the implementation of CSAs. This suggests that women did not acquire new skills that allowed them to expand their productive roles, but rather than CSAs solidified their ties to the domestic sphere.

"But now, we talk:" Respect and Decision-Making

Despite limited changes in labor roles, women used the physical space of the garden to increase dialogue with their spouses, which, they told me, had important consequences on the affective qualities of their relationship. The gardens also brought men and women together

frequently in a small space to complete tedious and repetitive tasks, such as weeding or mixing fertilizer into the soil before planting. This space gave women the opportunity to speak with their husbands as they worked alongside and to share experiences and opinions they might have kept to themselves in the past.

Carolina described to me how she and her husband would often talk together in their CSA garden as they weeded or watered, discussing both the state of the garden and any number of non-farm related topics. I often passed by their house on my way to Popayán at the end of a day to see them working side-by-side in their garden. Jorge shared a similar perspective, commenting that "[Now] at least we have more conversation. Being there in the work related to the gardens, we have something different to talk about."

Celia was emphatic about the changes she had seen in her relationship because of the CSAs and the workshops to learn about them. She described the changes to me in the following way:

> The time that we put into the garden and all of the workshops that we have gone to have been a place of great learning. We have learned how to speak to each other, something that before almost didn't exist. Before, because of x or y, sometimes we yelled at each other and things that like. But now it's not like that, we have been able to minimize the yelling...now, sometimes in the afternoons we sit down to talk. It's like I told you, talking has become a priority in my family.

She went on to describe the interest that her sons and partner now took in her life because of the CSAs and the CSA workshops that she was attending. They would ask, "and what did you learn today?" or "and what was the meeting about?"

Baseline data collected by the Gender and Climate Change Team in 2014, reflected that men made a majority of decisions about agricultural production, including on lots that are owned by women (Twyman et al. 2016). While not the case in every household implementing a CSA or the CSA gardens, many women told me that they were now more active in discussing and

making decisions with their spouses. While decision-making power and empowerment are desirable in their own right, enhancing them can also influence how household resources are allocated (Khan and Awan 2011; Peterman et al. 2015; Sell and Minot 2018).

María, Jimmy's wife, shared with us during the first workshop with Daniel how Jimmy assisted her in the garden. Laughing, she told us how Jimmy always asks her what should be done and exactly how it should be done before entering the garden. "He always says, 'women are the ones that should be in charge of the gardens,'" she told us. He always asks her, for example, "what side are you going to plant [this crop] on? And what side will you plant tomatoes on?" After María recounted this to our group, other women present agreed that their husbands defer to their expertise because women are the primary decision-makers in CSA gardens space.

These opportunities to speak together in or about the CSA gardens at times resulted in increasing women's participation in decision-making with their spouses in areas outside of CSAs. Celia explained to me when asked if processes of decision-making had changed in her house because of this new space of dialogue and collaboration:

> Yes, yes because, that's why I said to you that the dialogue has been really useful. Because at first everyone used to take care of their own tasks, but now its not like that. Now, we make all of the decisions together. Before giving someone an answer [about something] we talk. Before, [my husband and son] didn't involve me. They simply said, "I'm going to go mill [sugarcane]" and that was it. But now, no. Now, they consult with me about things.

However, this was less common and most women and men I spoke with stared at me with a puzzled expression when I asked, as if to say of course the dynamics of decision-making had not changed since the implementation of the CSAs. Many women, like Dulce, told me that they had already been involved in decisions about the day-to-day workings of the farm and felt that they had always participated equally in these decisions. An alternative explanation, As Luisa told me early in my fieldwork, was that the men in her household *think* that they are making decisions about the

workings of the household and farm, but it is really her—whispering in their ears—who makes the decisions.

Relatedly, CCAFS and Ecohabitats frequently discussed how to increase women's control over income as part of empowering women. Many ideas were brought up (and ultimately not implemented) to increase women's access to financial resources. Increasing income was often turned to by researchers as an easy fix for inequalities. However, my research tells a different story. While additional income was appreciated by women and their families, for most women, it was not significant in changing power dynamics in their households nor did it fulfil CCAFS' aims of transforming women's lives. Increased income generally upheld the traditional roles in power structures in households because women told me that they used it to care for their families through purchasing goods for their children or through reinvesting in the gardens that were primarily used to feed their families. As Carolina's husband described, "we continue on the same. If [Carolina] earns any money it goes into the money to support our family…we make the same decisions now [about money] that we did before."

Using CSA to Build Community Economies

Juliana welcomed me into her small, neatly swept and meticulously organized dirt-floor kitchen and seated me at the rough wooden table. I asked her how her garden had been and what she had planted in the recent weeks since I saw her last, as she looked around in the fridge for fruit to make me fresh juice. She was one of the women who had fully embraced the CSA gardens and diligently cared for her plants, enlisting the help of her husband when a minor injury confined her to her house for several weeks.

As her garden grew, so did her connections with her community and with communities across the river bordering the edge of El Danubio where she lived. Before her injury, she had started to take frequent trips on foot, walking first through El Danubio and then over the river

into the municipality of Cajibio where fresh foods were difficult to obtain because many families grew coca or cash crops and had limited access to transportation to get to markets. As she walked, she sold or gifted seeds, plants, and crops to the families she encountered on the way. Even now as she was mostly confined to her home, she continued to exchange seeds and share and sell the harvest from her garden. Although the extra income that Juliana generated from the garden was significant for her and her sense of independence from her husband, more important to her was being able to share her new prosperity and to contribute to her community. She described this to me:

> They come [to my house] and I give them a lot. I mean if they say to me, "sell me 1000 pesos [worth of a vegetable or herb]," I give them a big amount. To my family that lives in Popayán—my daughter, because she studies there, she lives with my brother—every eight days I send them [food from my garden]. I don't sell it or anything, I send it to them. Every eight days they get vegetables from here. I also send them beans.

This, she concluded, gives her, "a lot of satisfaction." "Yes," she told me, "you feel happier, right? Being able to help other people."

J.K. Gibson-Graham's notion of community economies illuminates how economies create space for more than just capitalist accumulation (2016). Community economies emphasize the strategic building of an economy to serve as an "ethical space of negotiated interdependence," turning away from the notion that economies are self-regulated and automatically produce well-being for all as each economic actor acts in their own self-interest. In Cauca, women implementing CSAs, while at times frustrated with the technologies offered by CCAFS and Ecohabitats, embraced the CSA tools and technologies as new ways to care for their community and to expand their social networks. Over several years, I watched women come together around CSAs and form strong women-centered social networks. At the heart of these

women-centered social networks was the sharing of seeds, herbs, and knowledge, all catalyzed by the implementation of—and the challenges of managing—CSAs.

Eleanora, a young mother of two and new to gardening, explained to me that the greatest benefit of her CSA garden has been to make new friends, which has also given her a wider social network that she can depend on during times of need. She once felt very isolated in her home as a young mother of two children, but the garden had given neighbors and distant community members a reason to stop by and share experiences and advice. Eleanora told me:

> So this would be another benefit, that everyone asks about the gardens. I mean that we start talking and get information about the gardens and also new friends because sometimes—even women from other veredas—will say, "look, I planted something and it died." So you can talk with them about this too, "look, I planted the same thing and it didn't die." So, for me, it would be this.

Carmen began regularly dropping by Eleonora's house—sometimes stopping when I was with her—located at the edge of the dirt road that led from Los Cerrillos to Popayán to check in on her garden and to offer advice and motivation to Eleonora who struggled for several months to establish her garden as the newly emerging plants were first carried away in pieces by leaf-cutter ants and then succumbed to the blazing sun. Although Eleonora was unable to attend many of the trainings organized by Ecohabitats because her children kept her close to her house, her newfound friendships resulted in learning about many of the techniques shared in these spaces.

The distances between neighbors and communities are sometimes vast in the region where the climate smart village is located and women often do not have access to their own means of transportation. I spent many hours walking up and down mountains in the hot sun visiting different farms and understanding intimately how quickly traveling on foot becomes burdensome. These distances have sometimes left local women feeling isolated. Lourdes described the change in her life saying that, "before, you were here in the house and didn't leave

even to go to a meeting." After she planted a CSA garden, I would often run into her on her husband's motorcycle as she drove slowly down the road toward Popayán selling vegetables and yogurt she made on her farm.

Products created from CSAs were significant in expanding social networks because they provided low value material goods to trade or share. Women controlled most of the low value products resulting from the CSAs—like seed or crops—and were able to decide how to use them independently of their husbands because of their low value. Other CSAs implemented and managed by men with the aim of increasing income by diversifying on-farm production (for example, a new pasture management system for cattle or small tilapia ponds) did not result in low value products that could be easily traded or gifted. Rather, these CSAs fit neatly into CCAFS' aim of increasing farmer income by resulting in high value goods for commercial purposes.

Women, on the other hand, resisted the capitalist integration promoted by CCAFS' through CSA, rather formulating community economies that used the goods they produced to achieve communal health and well-being. A core group of women from Los Cerrillos, El Danubio and Las Mercedes attended meetings about what tasks they would need to undertake to successfully commercialize their crops in Popayán and then, with the exception of Carmen, returned to their homes and did none or very few of the recommended tasks that would ensure constant production for marketing. While in a few households women did actively and almost exclusively market their crops, most women were more invested in gifting or trading the surplus crops and seeds and only occasionally sold small amounts of garden crops or herbs within their communities.

Doris was one of the women who sometimes participated in the meetings about commercializing crops, but did not seem actively interested in seeking out opportunities to market the harvest from her garden. I had assumed that this was because she only had enough to feed her family, but when I visited her garden I noticed that she had an overabundance of mint, cilantro, and onions. Mint had spread over rows and occupied a corner of the garden, shaded by the beans and winding up the side of the garden in the black plastic netting that Doris had hung to keep chickens out. When I asked her why she did not pursue selling the excess from her garden she told me that, "it would be shameful. How could I do that, when there are others here who need food."

Because many women did not systematically plant their gardens to produce small amounts of different crops consistently, which they referred to as "staggered planting" (*sembrar escalonado*), they often had periods of time where they would have far too much of a certain crop for household consumption. I visited many gardens overflowing with so much cilantro or Swiss chard that women had no other choice but to gift it to neighbors or to leave it rotting in the ground.[8] Celia told me that in this situation, "at least with cilantro, it doesn't last long before it flowers…So to not waste [the excess] you have to share it with others." It was common sense to gift the excess, implied Gabriela, one of the few women who had implemented a circular garden, as I scribbled notes while she watered her garden. "When you have an abundance," she told me, "you always gift it to the people that need it."

While small gifts of seeds, plants, or harvested crops were frequently the result of surplus, they were also gifted with the intention of expressing care and friendship and sometimes in hopes of forming a connection based on reciprocity, which would result in the giver becoming

[8] In some instances women had become known by neighbors to consistently have surplus that they would sell. However, in many cases, the surplus was inconsistent, leaving women to gift it to neighbors or relatives.

the receiver in a future exchange. When I asked how relationships within Los Cerrillos had changed because of the CSA gardens, Bárbara described to me the ways that friendships had taken root alongside the plants in their gardens. "Yes," she told me, " this is clear because you go out of your house and integrate yourself with your *compañeras*." She continued:

> One of them might say, 'in my garden I planted whatever and it turned out like this.' And at least with your good friends you might say, 'I'm gifting you this plant, take it, plant it." We all, sometimes, share.

Bárbara went on to explain to me that this was new following the implementation of the CSA gardens. Before the gardens, they "didn't have [anything to share]…It was unusual to see *half a garden*, the only thing planted was cilantro and nothing else."

Following the implementation of the CSA gardens, most women noted that they had begun to more diligently save seeds, sometimes filling large plastic jars to the brim with far more seeds than they could ever plant, which resulted in freely sharing seeds with neighbors and friends. Some women began folding seeds into small scraps of paper and carrying them to meetings and friends' houses to exchange. Carmen was especially involved in the exchange of seeds and often sent several different varieties of seeds with me to distribute as I did interviews or visited homes.

Feminist scholars have long brought attention to care—both the process of caring and who does care work—within the reproductive sphere (Graham 1991). In expanding theories of care, feminist scholars of Science and Technology Studies have more recently analyzed how care becomes entangled with technologies, both as related to the imposition of technologies on communities in the name of care and in how and why communities and individuals leverage technologies to enact care (Martin et al. 2015). In Cauca, through the process of gifting and trading crops, women used CSAs to enact a politics of care that not only subverted the capitalist

underpinning of CSA, but also contributed to the future survival of their communities during a period when farmers are increasingly living in a state of climate-related precarity. Carmen sums up the changes that have taken place this way:

> Before the [CSA] gardens, before being in community, I was here closed off within myself. Now I can speak with everyone, I can smile. We have something in common that isn't gossip, but is something that interests us. I have changed a lot. So this thing in common can open doors, it has made my emotional quality of life better, and my health.

The strengthening of social networks and diversification of crop varieties within and between communities is an unexpected result of a CSA technology and an unanticipated way that women farmers increased their adaptive capacity. Most of the women I spoke with agreed that they could now call on the support of neighbors or friends during the most difficult times of the year when heavy rains or drought affected crops. This reflects an important avenue for building the adaptive capacity of women, particularly since many women—including those in the Cauca climate smart village—do not have access to as many assets as men (such as land, credits, inputs, or technologies) that serve to soften the effects of climate shocks or climate change for farmers (Aguilar 2009). However, despite supporting women's adaptive capacity, the CSAs targeting women also reified women's traditional roles as caregivers ultimately limiting women's avenues for empowerment by failing to recognize structural causes of gendered inequalities.

CHAPTER 5: FEEDING A FUTURE WORLD: CSA AND FOOD SYSTEMS

"Transformed food systems will do this," Ana Maria said during her presentation at the Annual Program Review held in August 2018 at CIAT. What Ana Maria was explaining in this presentation was that transforming food systems will reduce hunger, greenhouse gas emissions, and combat climate change, which are three of the Sustainable Development Goals adopted by the UN Member States in 2015 (numbers 2, 12, and 13) that loosely guide CCAFS' agendas and objectives. CCAFS, Ana Maria explained, is already engaging in transformative approaches and is well positioned to become the most influential program for understanding and transforming food systems because of their multifaceted approach rooted in climate smart agriculture. At the center of transforming food systems are farmers armed with technologies to revolutionize production and scientists and researchers prepared to work on developing new technologies and on changing the political landscape to shift patterns of production, the movement of food products, and consumption.

While Ana Maria's talk was intended to inspire action and support for moving CCAFS toward a more holistic approach to climate change and food security, there was some pushback after her talk from other researchers in the audience. Several senior researchers spoke up about how CCAFS seemed to be losing sight of its original call to address climate change by moving into a focus on food systems; they critiqued the ways that CCAFS was promoting transformation as partial and insufficient in creating meaningful change globally. I am struck by this moment because during the entirety of my fieldwork, I had understood food systems to be tangential to

the experiments conducted in the climate smart villages. Food, from my persepctive, was a question pushed forward by Ecohabitats and farmers and not particularly supported by CCAFS.

The relevance of Ana Maria's talk was not just limited to CCAFS, however. Much of the discussion and planning for future projects during the later period of my fieldwork was oriented toward realigning different project areas at CIAT, including CCAFS, to engage with questions related to the food system. This shift reflected a growing concern among development practitioners about the long term viability of our current food system globally. On the ground in Cauca as well, food was of primary concern and most of the CSAs implemented were oriented toward increasing the food security and nutrition of the communities implementing these technologies.

As CCAFS moved into their third year working in the Cauca climate smart village, the coordinating team was interested in determining quantifiable impacts of the CSAs locally. As discussed in earlier chapters, a result of this focus was that I was encouraged to restructure my project and conduct research that would explore the effects of CSA broadly. Deissy Martínez, the Regional Program Coordinator for CCAFS in Latin American, proposed that I focus on the topic of food security as related to the implementation of the various CSAs with a special focus on the impacts of the CSA gardens. I realigned my project, integrating an analysis of how food security and food sovereignty were affected by the introduction of CSA in Cauca. In this chapter, I explore the dynamics of CSAs and food systems.

Drawing from fieldwork at the institutional and local levels, I analyze whether and how CSA has achieved the stated goal of transforming local and global food systems. CSAs are positioned to address the fears of scientists and the international development community alike that climate change will increase food insecurity (FAO 2008; Schmidhuber and Tubiello 2007;

among others). Although CSA, as defined and employed by CCAFS, attempts to ensure global food security for the future, I show that CSA ultimately reproduces the corporate food regime and its limitations (Holt-Giménez and Altieri: 2013) by relying heavily on biotechnologies to solve the impending food crisis. Rather than create possibilities for food secure and sustainable futures, this approach further marginalizes smallholder farmers and limits future biodiversity while burdening small scale farmers with the responsibility of feeding the world.

Despite the limitations that CSA presents in transforming food systems and in increasing food security, the imposition of CSA in the Cauca climate smart village has not been wholly detrimental to the local food system. My research shows that the dissemination of CSAs—namely the climate smart home gardens and the biofortified and climate resilient beans—is correlated to an increase in both the consumption of foods produced and the diversity of crops produced and consumed locally (all are important markers of food sovereignty). These changes were catalyzed by community organizing in which CSA technologies played a central role. Although CSA is unable to address the structural and historical causes of food insecurity, the associated tools and technologies have been integral to efforts by local farmers to push back against the corporatization of the food system by using CSAs to recuperate traditional varieties and revitalize seed trading networks.

Feeding the Future: An Institutional Perspective

As outlined in an early document published by CCAFS and FAO, one of the overall aims of CSA is to ensure present and future food security (Lipper et al. 2014). Although CSA encompasses three pillars—mitigation, adaptation, and production—the prioritization of these pillars has varied across climate smart villages depending on local and national context in which a particular village is located. Addressing mitigation has been primarily reserved for high income countries while adaptation and productivity have been central focuses in middle and low income

countries, which are the areas where CCAFS' climate smart villages are located (for example, Colombia, Nicaragua, Honduras, India, Bangladesh, Nepal) (Totin et al. 2018). Food security within a framework of CSA contributes to corporatization of the global food system, ultimately reproducing the very problems it aims to correct.

In the document mentioned above, food security is understood to be achieved through three objectives: "(1) sustainably increasing agricultural productivity to support equitable increases in incomes, food security and development; (2) adapting and building resilience to climate change from the farm to national levels; and (3) developing opportunities to reduce GHG emissions from agriculture compared with past trends" (Lipper et al. 2014). While in the case of the third objective, the link between reducing greenhouse gas emissions and food security may not be apparent, the CCAFS East Africa Strategy for 2019-2021 outlines this link in clearer terms. In the East Africa Strategy, CCAFS explains that storing of greenhouse gases in soils, or all together reducing greenhouse gas emissions in the agricultural sector, will mitigate climate change in the long term, which will ensure ongoing agricultural productivity (Solomon et al. 2018). Together, these three objectives primarily rely on increasing agricultural production to achieve global food security. Before turning to the implications of a focus on productivity, I briefly outline here what food security encompasses and how a framework of food security was operationalized by CCAFS in the climate smart villages.

The concept of food security first emerged in the 1970s as a result of the efforts of international development regimes—such as FAO and the World Bank—to understand the relationship between production, inequalities, and hunger. When first conceptualized, food security narrowly focused on the ability of households to obtain adequate food supplies through purchasing power, ignoring the links between self-sufficiency, subsistence farming, and food

security. This early conceptualization of food security is important to consider because it resulted in structural adjustment programs, trade liberalization, and farmer integration into global markets as proposed solutions to food insecurity (Jarosz 2014). Because of this history, solutions to food insecurity are largely focused around short term technological implementations to decrease food scarcity through improved production (Hopma 2014; Jarosz 2014, Lewis 2015). These types of solutions, I argue, continue to shape CCAFS' approaches to addressing food security, which I discuss more below.

Because of calls from *La Via Campesina* and other food sovereignty activists, the definition of food security has shifted to include attention to how social inequalities shape access to food at different times of the year. Food security now is understood to include four central pillars: access to, availability, utilization, and stability of food. This definition encompasses questions of access during the entirety of the year as well as the ability of individuals to process nutrients (which might be affected by health conditions, for example). Despite this expansion of food security as a concept to incorporate how unequal relations of power shape realities of food, research on food security remains rooted in neoliberal ideologies and, accordingly, proposes a narrow set of solutions (Jarosz 2014; Sachs and Patel-Campillo 2014). While we see these trends mirrored in the definitions and mobilizations of food security as a guiding theoretical concept in the climate smart villages, the historical entanglements of food security and neoliberal ideologies continue to shape how CCAFS conceptualizes problems and solutions related to local and global food systems.

Within the Cauca climate smart village, an aim of increasing local food security was central to shaping most of CCAFS' activities largely because of the efforts of Ecohabitats to address the failures of the local food system. As Luis noted, adaptation and food security should

always be understood as co-existing processes because food security is a key component of vulnerability to climate change. In this same interview he described the arduous process of convincing Andy and the director of CIAT, Ruben Echeverria, that a CSA such as the climate adapted home gardens would be a viable and important adaptive technology to implement.

The resistance he received was linked to the fact that home gardens are not an easily scalable technology, but rather depend on synergetic relationships between multiple CSAs (fertilizer, seeds, water storage systems, etc.). Although Ecohabitats attempted to create a more holistic approach to addressing the local food system in Cauca by turning to food sovereignty as a theoretical and methodological guide, they were limited by the demands to show high impact to donors and to implement new strategies or technologies as part of CSA. Additionally, CCAFS exclusively relied on a framework of food security to guide their activities and subsequent evaluation of changes in the food system suggesting that the more radical roots of a food sovereignty approach did not match their objectives.

Food security, as reflected in CCAFS' monitoring and evaluation surveys administered in the climate smart villages in 2018, was understood to be related to three pillars: access to, availability of, and stability of food. Questions did not encompass where food was purchased or produced, but rather whether there was enough of it during all times of the year, regardless of quality, diversity in nutritional content, or how it aligned with foods that campesinos wanted to eat. This conceptualization differed from how farmers in the Cauca climate smart village understood the concept of food security.

Mayra, one of the young women who became a close collaborator, pushed back against CCAFS' understanding of food security captured by the surveys. She had been one of the farmers selected as an enumerator for the survey and, as such, had been tasked with interviewing

families and recording their answers in a version of the survey she carried around with her in a tablet. When we spoke about this section of the interview she told me that farmers were confused by the questions because they did not align with local understandings of food.

For example, Mayra noted that most of the people she surveyed answered that they had not rationed food in the past year (a marker of food insecurity) because they were able to buy low quality staple foods in the city and bring these to their farms. However, for Mayra, purchasing staples—like the potatoes, eggs, and rice she named—to sustain you is not food security. Mayra emphasized that, "buying food in the city isn't the same as having it here…[it's not the same] as you harvesting it yourself." Liliana agreed with Mayra's perspective, emphasizing in workshops and meetings that correcting the food system is about "having the refrigerator full of products from the fincas." The emphasis from the farmers in the Cauca climate smart village was on increasing their power and control over the means of production, a key component of food sovereignty. CCAFS, on the other hand, was concerned with increasing key micronutrient concentrations in certain crops (iron, zinc, Vitamin A) and the total food supply that would permit them to claim large scale impacts.

Although Ana Maria and Deissy prioritized, and continue to prioritize, addressing food security through a multifaceted approach in the Latin American climate smart villages—encompassing policy measures and creating conditions for transformations in social life—as multiple researchers at CIAT noted, the primary method for achieving widespread food security was through scaling up and scaling out technologies. Scaling up and out was the principal method for achieving food security because, as explained above, food security is understood by CCAFS to be related to increases in productivity. It is less important *where* the food comes from than how much food is available. This focus too was evident at the local and regional levels

where the major focus of CCAFS' activities involved implementing new technologies and practices to increase production. In other words, global food security is understood to follow increases in production of food by smallholder farmers permitted by the widespread implementation of biotechnologies.

There were two methods of scaling out and up. The first, as described by one researcher at CIAT who had worked extensively in the Cauca climate smart village, entailed the development of adaptive measures by CCAFS and the "selling of" these adaptive strategies to other "stakeholders" or regional, national, and international actors. This form of scaling out of technologies took a different shape depending on the context. Andy described in an interview that in Bihar, India, CCAFS supported the implementation of a variety of climate smart rice that aims to increase yields. This rice was first tested in the climate smart village and then made available to other farmers to maximize impact. In Senegal, climate information services were tested in the climate smart village and then spread to 6 million farmers. Despite the differences across context, the replication of technologies to increase production of different crops was central to scaling out and therefore to achieving maximum impact.

In the Cauca climate smart village, Liliana and Luis were tasked with scaling out and scaling up at the regional level. They commented that when they were first charged with this task, they were confused about what exactly scaling up and out entailed because it did not align with their focus on supporting a local community. As part of efforts to satisfy their role in scaling out, or in spreading technologies regionally and nationally, they began approaching different local governmental and non-governmental organizations about implementing the climate smart gardens throughout Cauca and in other regions of Colombia. During the early period of my fieldwork, the branch of the regional government in Cauca that supports local farmers, UMATA,

paid to implement the climate smart gardens in various households as part of a collaboration with CCAFS orchestrated to scale out technologies as a means of creating impact.

Many of these gardens, local farmers grumbled, sat vacant with plastic falling from the bamboo structures, and were unused by the families that received them. I asked Yesenia, the neighbor of one of the recipients of a CSA garden that was unplanted nearly a year after it was built, what she thought about this. She told me:

> I would say that this is…an envy [that people without gardens had]. I would say that [people who were not interested in gardens asked for them] sometimes because of envy. Because, for me, for example, if they are going to give me a garden like that and I know that I don't like [to garden], why would I receive it, right? I know that they could give it to someone else who *does* want it…So for me, it is envy or selfishness…because there are a lot of people who did receive CSA gardens and have nothing [planted in the garden].

I heard this narrative echoed by other community members and by Luis and Liliana who also sometimes added that people did not plant their gardens because of "laziness." They assumed that if the technology was offered, it would be used. Anyone who left the CSA technologies unused were marked as lazy or selfish. This explanation, however, obscures the structural reasons behind the failures of recipients of CSAs to use these technologies and practices that I explored in Chapter Three. However, the point I want to emphasize here is not related to the structural reasons behind CSAs going unused, but rather how the simple scaling up and out of technologies is insufficient for ensuring that they are used.

Detached from Ecohabitat's careful programming to motivate, monitor, and support farmers in using CSAs, many farmers did not plant their gardens. Although CCAFS Latin America insists that they are not relying solely on the replication of technologies to facilitate changes in the food system (interview with Deissy), this is what is happening in practice with both the CSA gardens and the climate resistant and biofortified beans as they move outside of the

Cauca climate smart village. As I described in Chapter 3, farmers are left without support systems to navigate the management of tools and technologies that are unfamiliar to them, resulting in frustration on the part of farmers when tools or technologies do not work as expected or in the abandonment of these technologies before initial implementation.

Despite this failure of a process of scaling up and scaling out, CCAFS has begun to look outside of public sector arrangements to widen the impacts of their CSAs. The private sector holds potential for scaling up and out CSAs by providing capital for their widespread replication as a strategy of creating corporate profits. As Deissy noted, it is much easier to convince the private sector to scale [adaptive practices and technologies because] if they see [CSA] as viable economically, they see that [CSA] is good for business and simply adopt it and keep doing it." During my period of fieldwork, many CCAFS leaders spoke about forging ties to private sector corporations. Although this did not occur in any widespread way during my fieldwork, it raises concerns about the potential privatization of technologies, seeds, and practices for farmers as corporations purchase the rights to CSAs, potentially limiting farmer access to seeds or other modes of production. One former researcher at CIAT, who wished to remain anonymous, privately worried that links with the private sector could also lead to increases in contract farming and land consolidation. Concerns over the privatization of CSA reflects what Harvey (2003) refers to as "dispossession by accumulation" in which seeds, lands, or traditional farming practices become enclosed by private ownership, removing the rights of campesinos globally to freely utilize methods of production that they have used for centuries.

The second method of scaling selectively appropriated elements of the *campesino a campesino* (farmer to farmer) methodology developed by *La Via Campesina*. In this method, a farmer develops a new practice through on-farm experimentation. After achieving the desired

results, the farmer who created the practice then shows it to other farmers who are encouraged to implement the practice or technology on their own lands and, in turn, share this knowledge (and any improvements or modifications they have made) with other farmers. This method is centered around incorporating farmers as scientists and knowledge creators in their own right as farmers are involved in all steps of developing and disseminating a new practice or technology (Holt-Gimenez 2008; Tello 2011). Campesino a campesino is inextricably intertwined with an agroecological approach to transforming food systems that centers the application of certain principles that strive for agroecological balance, rather than by applying prescriptive technologies or practices (Rosset et al. 2011). Evidence, particularly from Cuba, supports the claim that agroecology offers an alternative to the corporate food regimes that could potentially support the livelihoods of smallholder farmers, eliminate hunger, and increase global agroecosystem resilience (Holt-Giménez and Altieri 2013; Rosset et al. 2011).

While using the campesino a campesino methodology aimed to incorporate farmers as co-constructors of technologies and practices in the climate smart villages, there were several key differences between La Via Campesina's conceptualization of the farmer to farmer approach and CCAFS's conceptualization. In general, practices and technologies are intended to be developed by the farmer in order to address local needs and visions for the future. Rather than integrate farmers into projects, campesino a campesino aims to create a "broad-based movement" with farmers as the central actors and decision-makers (Holt-Gimenez 1996). In the Cauca climate smart village, farmers played the role of testing and disseminating already developed technologies, acting as key agents for replicating technologies rather than as

producers of knowledge and technologies that aimed at transformations in the food system through an agroecological lens.[9]

While scaling up and scaling out are relied upon by CCAFS to increase overall production of food, another key component of increasing regional and global food security is related to farmer engagement in markets. In Cauca, because of the efforts of Ecohabitats, farmers are encouraged to first feed their families with the crops resulting from CSAs and then market the surplus. Any income from CSAs, it is assumed by CCAFS in Cauca, will be used to purchase healthy foods, thereby increasing food security of the farming families implementing CSAs. In other climate smart villages, this focus on integrating farmers into markets has resulted in a shift away from subsistence farming to one focused on producing large quantities of crops using mainly the climate resistant seeds engineered and disseminated by CCAFS (Dembele 2017).

In a session streamed online from the 2017 Conference of the Parties in Paris, Bruce Campell, the Director of CCAFS, discussed the relationship between and engagement in the private sector through markets. This, noted Bruce, will ultimately lead to "winners and losers" among the farmers that employ CSA as some farmers will be more successfully integrated into markets and therefore benefit more than other farmers. Although CCAFS, he went on to explain, could support the "losing" farmers through government programs, CSA will ultimately serve certain farmers over others. This moment reflects that although CCAFS, at the institutional level, understands that employing CSA within a capitalist system will result in the remarginalization of

[9] Jimmy was involved to some extent in the development of the climate smart garden. It was unclear in interviews how active he was in contributing to the design of the garden. Additionally, despite Jimmy's integration into the development of this model, I still argue that the climate smart garden is a technology imposed by CCAFS rather than developed in collaboration with farmers. At the moment of developing the designs for the garden, Jimmy had very little experience working in gardens and, as Luis described, the garden model was largely developed by copying elements of gardens that he had seen in other places, about which he could not remember when asked. Rather than develop gardens in collaboration with women, who had traditionally been garden caretakers, the CSA garden model was developed and then implemented as a technology that women were tasked to manage.

certain farmers and their families, they have accepted these failures as inevitable rather than seeking solutions that push back against the status quo and the corporatization of the agricultural sector.

This raises the question, "for whom is food security?" In the case of CSA, because adaptation and food security have been coupled together, smallholder farmers have been recruited by CCAFS to replicate adaptive tools and strategies created outside of a local context to increase total production of food. These solutions, stemming from the concept of food security, are built upon the assumption that the world's poor are both responsible for their own hunger and for alleviating their hunger by increasing income, agricultural production, or both income and production simultaneously (Jarosz 2014). Structural factors that create inequalities in access to food are overlooked in favor of increasing individual agency, entrepreneurship, and technological advancements (Jarosz 2014; Sachs and Patel-Campillo 2014).

"They Don't Really Care About the Farmers": Donor Relations and Scalable Impacts

The reliance on scaling up and scaling out to prepare farmers to adapt to climate change and to construct a food secure future, explained Luis, was mainly from the pressure to show widespread impacts to donors. An appropriate scale of impact, I learned from interviews and meetings, was somewhere between the millions and the entire, rapidly growing global population. As Andy explained, "Our mission and the way we operate is more about scale. We need scale. We can't go back to donors and say we have 50 happy farmers. That's not a development objective."

Sally Brooks (2010) describes how HarvestPlus—another research program of the CGIAR which I discuss in more detail in the next section—shifted the role of the CGIAR centers from research institutions to "brokers" of "international public goods" (biofortified rice in the case of Brooks' research) for dissemination worldwide. CCAFS has largely followed this broker

model set by HarvestPlus as they test and then scale out technologies to NGOs, governments, and potentially the private sector. Although CCAFS claims to work through participatory processes that engage farmers as decision-makers and stakeholders, one researcher pointed out that this was not how they broadly conceptualized their role in intervening in the agricultural sector:

> CCAFS is trying to say that their main interventions aren't with farmers. Because their CSVs are sites to test things and… they are pressured to deliver at scale…. So they don't really care [about farmers]. I mean they do care in terms of showing what they need to show in saying that these practices are useful, but beyond that I don't…I get the impression that they don't care because they have to show impact at scale.

While in the Latin American climate smart villages Deissy and Ana María were interested in reproducing *social processes* rather than a singular practice or crop variety, to facilitate impact at scale their planning processes were limited to demands from donors. As Deissy described:

> When you talk about the Cauca climate smart village and say that everything is a *process* and all that, right, no one is going to tell you that they aren't in agreement. What happens is that, after, they are going to say, "okay, great, you are going to do all of that there and how many farmers are you impacting and how many are you reaching…" The vision [of the donors] is "I give you so much money and I need there to be so many farmers [impacted]."

Despite stated intentions by much of CCAFS leadership to not simply rely on a technological fix, this was undermined by the demands of donors to show large numbers of farmers impacted. If a farmer received a technology, regardless of difficulties in use or how the technology may or may not compound preexisting vulnerabilities at a household or community level, CCAFS could include each recipient as a measurement of impact.

"[What] the bigger investment players are looking [for] in agriculture," explained Andy, "they're looking for much more systemic and transformational options in agriculture and we haven't gotten enough of them in the climate smart villages." A farmer to farmer approach—

despite CCAFS employing it primarily to disseminate already made adaptive technologies—in Andy's opinion, was unable to transform food systems because it did not generate enough impact and used high cost methods of transferring information, services, and technologies. Because of this logic about mechanisms of creating impact, greater emphasis across the climate smart villages was placed on widespread replication of practices or crops that could be disseminated at scale by governments, corporations, or large farmer unions.

The pressure to show impact at scale to donors also led to the construction of a narrative about CSAs by CCAFS that invisibilized failures. This type of narrative is widespread in global development work as pressures from donors to create "success stories" become part of the conditions to receive future funding, ultimately resulting in NGOs and other organizations "covering up" their failures (Hunsberger 2010). CCAFS, likewise, constructed narratives of success and impact for donors, providing simple explanations about access and knowledge in cases where CSAs were not adopted.

According to the working paper mentioned in Chapter Three, published by CCAFS in 2018, farmers did not adopt CSAs because of a lack of knowledge or access to assets (Howland et al. 2018). The paper did not consider that some farmers may not have adopted because a certain practice or technology is not commensurable with their cosmovision. Rather, this working paper asserted the supremacy of scientifically driven production over non-scientifically driven production and was built on the premise that CSA offers a suite of highly effective technologies that will improve farmer life. Of course, CCAFS asserts, when farmers have access to this knowledge set and adequate resources, they will adopt CSAs.

Anthropologists push back against this simple narrative of access and knowledge, highlighting the complexities of agricultural production as a social endeavor (Crane et al. 2011).

Rather than simply a question of access to resources and knowledge, agricultural production can be understood as a *performance*. Understanding agriculture as a performance seeks to highlight agricultural knowledge not only as "something that is simply deliberated upon and used to reach a decision," but as an "embodied act" or "tacit knowledge" that can be acted upon with a degree of spontaneity (Crane et al. 2011). This is not to deny that limited access to knowledge and resources make it unlikely that farmers from will adapt to climate change. However, this perspective is significant in challenging the narrative that scientifically driven production and modernization of agricultural production will always win out over other models of agricultural production.

When I accompanied visitors from outside CCAFS on field visits to the Cauca climate smart village, we always visited the same five or six farms of the producers who had, according to CIAT's criteria, "successfully" implemented CSAs. These farmers were those who were both the most educated and who had a history of involvement in local political life, which suggests that they had experiences navigating bureaucratic relationships with local governments and in managing and utilizing the productive resources that came following involvement in farmers associations or unions. Instead of spending resources or time on discovering why a particular farmer was not using a technology, these farmers were often referred to as "lazy" or described as disinterested by Ecohabitats and community members alike because of their refusal or inability to conform to the ways CCAFS envisioned CSAs being used.

During 2018, under ever increasing pressure from CCAFS to scale out, Luis sought to convince NGOs, farmers associations, and governments to adopt and implement the climate smart gardens in other communities throughout Colombia. However, it was clear that this scale of impact fell short of CCAFS' targets. Andy characterized the adaptive technologies and

practices implemented in the Cauca climate smart village as "incremental adaptations." These adaptive strategies, he explained, were developed from a participatory process in the Cauca climate smart village led by Ecohabitats that encourages more farmer involvement in the development of practices and technologies implemented when compared to other climate smart villages and, as such, are strategies that do not offer the scale of impact CCAFS needs to demonstrate efficacy of CSA.

Because donors required widespread impact, CCAFS was less concerned with promoting a diverse food system under the control of local farmers or with addressing inequalities in access to food, than with increasing the total amount of food produced. Rather than address the complex social and structural factors, pressure from donors has resulted in a turn to a "magic bullet" solution that is easily scalable and implementable on the lands of millions of farmers to increase production, which, the logic follows, will "achieve food and nutrition security for all people at all times" (Lippert et. al, 2010). I turn to the case of the hybridized beans to analyze in more detail the consequences of a reliance on replicating biotechnologies to solve the perceived global food crisis and for cultivating future food sovereignty and agro-biodiversity.

"Seeds of Peace:" The Promises and Limitations of Biofortified Beans

Marilia Nutti, the Coordinator of HarvestPlus in Latin American Countries, explained at CIAT's Annual Program Review in 2018 that biofortified beans provide triple gains for farmers because they provide high yields, are resistant to drought and heavy rains, and increase the nutritional status of farmers and their families. In the Cauca climate smart village, there were three different categories of beans planted that have been bred by CIAT: disease resistant, climate resistant, and biofortified (and climate resistant) varieties.[10] All of the varieties were

[10] The climate resistant and biofortified varieties in the Cauca CSV are BIO 101 and BIO 107. The climate resistant variety is SAB 618 and the plague resistent varities are MAC 74, el BAT 51 y MRC 8. BIO-101, BIO 107, SAB 618

planted to diversify food sources for farmers, thereby increasing nutrition, and provide an entry point into a market-based economy as the surplus from harvests can be sold at local markets. I focus this section largely on biofortified beans as they hope to provide all of the same benefits to farmers and their families as the climate and disease resistant beans, with one additional benefit—addressing micronutrient deficiencies—identified as key to battling "hidden hunger" in the Global South (HarvestPlus and FAO 2019).

I follow bean seeds—and the discourses that accompany them—as they travel from CIAT to the Cauca climate smart village to explore the contradictions between the promises of biofortified foods to increase nutrition and to transform the food system and the on-the-ground realities. By drawing from discourses of agroecology and "tradition," CCAFS has positioned these beans as a healthier and more sustainable solutions than GMO, heirloom, or conventional beans and as key to preemptively solving the future food crisis. However, discourses about beans are built on specific assumptions about how they will be disseminated and utilized in local contexts and the impacts that they will subsequently produce. Biofortified seeds offer a simple solution to a complex problem, ultimately distracting from structural problems that have led to inequalities in hunger and reifying the power dynamics inherent in the corporate agro-food system that marginalizes smallholder farmers.

Biofortification and the CGIAR: Nutritionism and "Hidden Hunger"

"So, we decided with the people in the Cauca climate smart village to do a practice run." Carlos, a now retired agronomist from CIAT, said in a workshop late one afternoon to a group of farmers and NGO directors from organizations in Valle de Cauca and a few individuals from the

and MAC 74 were the varities that Carmen favored the most for their production and resiliency during the time when I was conducting fieldwork. Because Carmen was key in disseminating these bean varities, these are the varieties that were most widespread (although campesinos often could not remember which specific varities they had planted).

World Bank who had come to do one of the "tours" of the Cauca climate smart village that were given with increasing frequency as pressure increased to scale out technologies. These tours were organized by Luis and Liliana so that they could share the adaptive measures being implemented in the Cauca climate smart village with the hopes of scaling out to interested stakeholders. Carmen and Carlos were in charge of the final session focused on the varieties of biofortified and climate resistant beans that had been tested in the village the previous July and were slowly being replicated on a growing numbers of farms in the area.

Carlos continued, "So, as an adaptive measure, we planted three varieties [of beans] that are resistant to drought. An adaptive measure using drought resistant varieties can help us, a little bit, to solve the effects of drought. These [varieties] were BIO-101, BIO-107 and SAB-618. BIO-101 and BIO-107, besides being resistant to drought, have the additional benefit of being biofortified." He went on to explain that, "one of the things that most affects children is anemia." He added that biofortified beans "are a good solution for that [anemia]."

In an interview with Elise Talmsa, a nutritionist who had worked at CIAT until 2017, she explained that the decision to breed for iron and zinc was rooted in an understanding that iron deficiency is a widespread problem in the Global South and resulted in significant developmental impairments and a low quality of life. More broadly, the biofortified beans are part of efforts by researchers in the agricultural sector to increase the global uptake of key nutrients (Vitamin A, iron, zinc, among others) and to increase global dietary diversity (from an interview with Elise Talsma and a meeting on Food Systems for Healthier Diets). Biofortification linked agriculture and public health together in new ways as low cost solutions were sought for nutrient deficiencies, allowing the CG to broaden the understanding of biofortified crops from merely

technologies to development interventions that would not only solve a public health crisis, but also alleviate poverty (Brooks 2010 and Johnson-Beebout 2012).

Biofortification of staple crops began in the 1990s with a shift toward addressing micronutrient deficiencies—or "hidden hunger"—in vulnerable populations, following a recognition in the scientific community that a focus on caloric intake and protein deficiency was insufficient for addressing inequalities in nutrition related challenges (Rao and Huggins 2017; Schnurr et. al 2018). Within the CGIAR, the research program mentioned in the previous section, HarvestPlus, emerged as a key player in the development, dissemination, and testing of biofortified foods as they attracted the support of large scale donors such as the Canadian government, Bill and Melinda Gates Foundation, and the German development organization, GIZ (Brooks 2010 and from an interview with José Restrepo).

Although biofortification is framed as a simple solution to micronutrient deficiency worldwide, this narrative formed in the wake of debates about biofortified rice between scientists over the relationships between bioavailability of nutrients and uptake of nutrients (related to whether bioavailability resulted in nutrient uptake or not). Following a series of papers analyzing these links in the 1990s (Graham and Welsh 1995, among others), the CGIAR simplified a narrative advocating for a holistic food systems approach—which accounted for unanswered questions regarding the relationship between bioavailability and uptake of nutrients—to one which claimed that modified and biofortified seeds were the answer to bettering nutrition. The early processes of developing and establishing biofortified foods were punctuated by moments such as this in which the CGIAR constructed a simplified narrative centered around a genetics-driven approach (Brooks 2010).

HarvestPlus was formalized in 2003 as a research program of the CGIAR coordinated across IFPRI (in Washington D.C.) and CIAT, and has been responsible for the development, release, and monitoring of biofortified crops for the CGIAR globally. During my fieldwork, HarvestPlus was in Phase Three of their program, which entailed concentrating on delivery and scaling up of biofortified crops following the first two phases that focused on identifying "target populations," conducting "proof-of-concept" research and running efficacy trials following the release of the first wave of biofortified crops (HarvestPlus n.d.).

Nutritionism, what Kimura (2013) describes as the scientific framework that gave rise to the concept of "hidden hunger" and to biofortification as a solution—is linked to a long history "problematizing people's food and bodies in the developing world" and of asserting scientific ways of analyzing the world—and in this case of solving malnutrition—as the most valid methods of producing knowledge. Under the framework of "hidden hunger," women become the primary targets of nutritional interventions, robbing them of their autonomy to make choices around food as scientific knowledge is deferred to and blaming women for malnutrition of children in the first place. Nutritionism further depoliticizes food by turning hunger and malnutrition into a problem with technological and market-based solutions as food becomes a matter of individual choice related to a lack of education or knowledge (Kimura 2013).

This assertion of scientific and market-based approaches to addressing nutrition globally was apparent in interviews with researchers at HarvestPlus and in meetings where their plans for future initiatives were shared. Goals to create a "breadbasket" of biofortified foods were discussed in addition to plans to promote and disseminate the varieties developed within the CGIAR through global markets to reach the "most vulnerable populations" (meeting of CIAT's Flagship Program: Food Systems for Healthier Diets). To promote biofortified beans,

HarvestPlus was interested in rebranding their crops and in some communities had changed the language of the packaging to integrate local understandings of food and nutrition.

For example, Marilia Nutti noted that rather than referring to beans as "iron-rich" on packages, in some countries HarvestPlus has labelled the beans as providing "more energy." Likewise, a high zinc content was translated to "increase[ing] defenses" [against sickness] so that mothers could easily identify these brands as healthy for their children. The rebranding and disseminating of biofortified foods positions them as superior to traditional varieties while obscuring the process of how they have been developed. These strategies of tailoring the discourses surrounding the beans—and, therefore, what the beans promised to provide—to a local context were also seen in the Cauca climate smart village where the beans fit into an existing framework of discourse about CSAs, adaptation, and food security that CCAFS had carefully constructed through the various phases of the climate smart village.

Biofortified Beans as CSAs: Experiences in the Cauca Climate Smart Village

The implementation of biofortified beans within the Cauca climate smart village aimed to support food security for farming families through increasing agro-biodiversity and providing a nutrient rich food source and by providing additional sources of income that could then be used to purchase food. Within this local context, biofortified beans were also understood to promote agroecological practices, as researchers discursively juxtaposed these beans to the genetically modified varieties of the Green Revolution. Ultimately, the dissemination and mobilization of biofortified beans within the climate smart villages are influenced by a number of assumptions about food security and sustainability that undermine the construction of food sovereign systems.

Carlos led the efforts to incorporate climate resistant and biofortified bean varieties into the Cauca climate smart village through a series of workshops on on how to produce, assess, and store high quality seeds through chemical-free techniques. Most of the techniques that he

explained were oriented toward permitting the farmers to produce what he called an "artisanal" bean seed of high quality that could then fetch a high price at market. He, Luis, Liliana, and Carmen explained to farmers at nearly every workshop or meeting in the Cauca climate smart village that biofortified beans would improve family health because they contained high amounts of iron and zinc.

Carmen in particular became an advocate for biofortified beans, referring to them as "excellent" in their production and nutritional qualities despite having little previous experience growing other varieties of beans and limited knowledge of the nutritional benefits. She took up the discourse that Carlos and Luis used to describe the beans, not having access to any of the scientific studies conducted on them. Carmen had been selected by Carlos and a Master's student working with him, Norma, to be one of the first implementers of beans on experimental plots in the Cauca climate smart village.

Farmers in Cauca were not told at these workshops that studies showed that an individual would need to eat beans twice a day for several months to increase their iron and zinc levels (Kolb et al. 2017). Additionally, because of the orientation of the workshops toward engaging farmers in markets, there was no discussion of how soil health or fertilizers could impact the quantities of zinc and iron found in the beans, particularly after several harvests when beans would have been saved from previous harvests for planting, "diluting" the genetic characteristics (interview with Elise Talsma).

It was assumed that increased production of beans would result in increased consumption. However, qualitative interviews and participant observation told a different story. As was the case with products from the CSA gardens, CCAFS encouraged families to cultivate these crops and use them for household-level consumption before selling any surplus. While

Ecohabitats and Carlos recognized that there was little "culture of consumption" of beans in this area of Colombia, they neglected to address this directly, instead relying on the presence of beans in the communities to increase consumption of the beans themselves. At a meeting with a group of farmers from San Antonio, the leader of the group, Mayra, spent nearly half the meeting convincing other farmers to implement these beans as a favor to Ecohabitats. Implementing these beans was strategic, she said, because they might receive more desirable subsidies, technologies, or support in the future from CCAFS if they did something that CCAFS wanted. The beans were not viewed by this group as a food source, but as part of negotiating support.

Despite the "family focus" that guided how CSAs were implemented, women were the main targets of biofortified beans because of their role in maintaining household food security and because, similar to CSA gardens, income from the biofortified beans was projected to lead to women's empowerment. However, biofortified beans did not always fit into the decisions women chose to make about feeding their families. Women often shared that they generally only turned to beans as a source of protein when they did not have the financial resources to purchase meat. If women did choose to prepare beans in instances not dictated by economic necessity, they told me that they usually threw only a handful of beans into a pot of soup. Even in the families where women commented that they were relying heavily on beans, they rarely consumed them more than twice a week. Despite claims from some women that "because of [CIAT's] beans, thanks to God we are not going to suffer," qualitative and quantitative data showed that bean consumption and commercialization (as a means to purchase other food sources) remained low.[11]

[11] Consumption of beans in the Cauca climate smart village was not high enough to affect iron or zinc levels. Papers published in 2016 from studies conducted in Rwanda indicated that women would need to eat beans twice a day for four and a half months to reduce iron deficiency (Murray-Kolb 2017). This far exceeded the bean consumption of any of the families I spoke with in Cauca.

Biofortified beans were also regarded and promoted by researchers as a more sustainable and environmentally conscientious option as they promised high yields with few inputs and distanced themselves from the modified varieties for large-scale monocropping produced under the Green Revolution. Researchers were careful to distinguish biofortified beans from conventional and GMO varieties, emphasizing the "natural" process of developing the beans. Biofortified beans, it was explained to me, came from "a traditional 'betterment' process through crossing [bean varieties]," which is " a natural" and "more biological" process of creating new bean varieties than genetically modified varieties (interviews with José Restrepo, Norma Barbosa, and researchers from HarvestPlus). This language suggests that the beans are superior to genetically modified and conventional varieties of seeds, yet also obscures the fact that the process is not naturally occurring and is, rather, the product of a carefully managed scientific process inaccessible to farmers despite CCAFS' intentions to "bring science to the field." While the process of bringing biofortified foods to farmers is claimed as "participatory," farmers in the Cauca climate smart village merely act as testers and replicators of already existing varieties created in laboratories.[12]

Likewise, the beans were described as an "agroecological" option by Ecohabitats and CIAT's researchers. Agroecology seeks to construct farming systems that mimic local ecosystems in diversity and synergetic relationships (in which networks of living systems find balance). Agroecological technologies should, therefore, be based in indigenous and local knowledge, drawn on already existing local resources, and sensitive to gender dynamics and local context as they seek to enhance on-farm productivity and stability of productive systems

[12] At HarvestPlus, there is more attention to integrating farmers into the development of beans. However, these processes are largely organized around bringing beans to farmers and having them assess different varieties for preferences related to taste, size, color, etc. Participatory processes in this context still exclude farmers from the science of developing varieties.

(Third World Network and SOCLA 2015). While CSA was often described as agroecological in the Cauca climate smart village, CCAFS selectively appropriated certain elements of agroecology that fit into their narratives about CSA, leaving aside those elements that would have otherwise challenged CSA as a framework for guiding the future of agricultural production.

Biofortified beans were described as agroecological by researchers and Ecohabitats because of certain characteristics of the beans themselves. The biofortified and climate resistant beans had been bred for resistance to plagues and drought, which, according to researchers eliminated the need for chemical inputs (except in exceptional cases), decreased labor demands, and uniquely supported smallholder farmers. Carlos described the hybridized varieties as best suited for small plots of land to maximize yields, noting that the beans would be less productive when planted as large scale monocultures. Biofortified and resistant beans, at first glance, appear to fit into a framework of agroecology by supporting diversity, chemical free production, and smallholder farmers. However, I argue that agroecology in the context of CSA reflects what researchers describe as a "technocratic framing" of agroecology in which the radical elements of agroecology related to questions of power and control in agricultural production have been cast aside (Holt-Giménez and Altieri 2016; Levidow et al. 2014; Levidow 2015). CSA supports the imposition on farmers of technologies developed under a Western, scientific worldview that prioritizes production and profit over balance.

Despite drawing upon a discourse of "sustainability" to differentiate hybridized bean varieties from the GMOs of the Green Revolution, biofortified beans were turned to by researchers to address the food system from a technological perspective and from a perspective of food security (emphasizing increases in production). This has limitations for the ways that we can reimagine the global food system and how we address inequalities in hunger. In Cauca,

rather than address systemic needs or build a new food system from the ground up, the deployment of technologies is driven by the need to show scalable impact to donors. In the next section, I analyze more directly the consequences of biofortified beans on agro-biodiversity, a key component of agroecology. I argue that hybridized varieties ultimately limit biodiversity despite claiming to support a more diverse agricultural system.

Eliminating the use of pesticides and herbicides, although supporting a more sustainable method of production, had further consequences for labor burdens of smallholder farmers, reflecting the reification of unequal power dynamics in which the Global South continues to be burdened with the responsibility of feeding the world. The dissemination of biofortified beans resulted in more work because famers "would have to be super attentive to their plots [of land]" where beans were grown, constantly monitoring plants for diseases and manually removing the leaves if signs of disease or pests appeared (interview with Norma Barbosa). This is a particular concern for women who are charged with the labor intensive care of feeding their families and, therefore, with the beans themselves. Farmers frequently spoke about an alternative and less labor intensive mode of increasing healthy and diverse food production through foraging when they reflected on the past.

Rather than support farmer driven initiatives such as a recuperation of traditional subsistence and foraging patterns, CCAFS supported the development and dissemination of a technology to ultimately procure additional capital for their organization. In multiple ways, biofortified foods reproduces the same problems of the corporate food system, which under the Green Revolution relied primarily on increasing production through agro-technologies and expansion of monocultures. While framing CSA as a means by which to strengthen smallholder farming systems that promote biodiversity and the well-being of farming communities

worldwide, smallholder farmers have at the same time become incorporated into the corporate food system as cheap labor mobilized to feed the world through the implementation of standardized practices and biotechnologies that co-opt the rhetoric of agroecology (Holt-Giménez and Altieri 2013).

Using CSA to Build Food Sovereignty

Six months after concluding my fieldwork, I received an email from a researcher working on the CCAFS team in Cali. She explained that CCAFS and Ecohabitats were planning to submit an abstract to a local conference on "Successful Cases of Innovation in Family Farming" and she had written to inquire if I could support the writing of the abstract. The theme for 2019 was "Agriculture and Nutrition." Andrea asked if I could share some specifics from my dissertation research that would fit into this theme to highlight women's involvement in CSAs and how the CSAs have been integral to women becoming involved in newly emerging organic markets in Cauca. "We also want to highlight how the families' diets diversify because of the home gardens," she ended her email.

I responded a few days later, puzzled that CCAFS seemed to recall my conclusion that the CSA gardens had served to diversify diets. What I had presented nine months earlier was that the CSA gardens had not caused any meaningful change in biodiversity of crops or in diet, but rather that farmer-driven processes of consciousness raising and organizing were behind any changes in diet or the broader food system. As far as I know, CCAFS submitted the abstract despite my response, claiming that the CSA gardens as adaptive innovations were driving forward changes in the food system as related to nutrition and biodiversity of crops.

This deliberate or accidental misremembering reflects the overarching narrative of successful impact rooted in neoliberal entrepreneurialism that CCAFS has constructed despite the data telling a more complex story. As one researcher at CIAT commented, "they've gotten

money for this so they need to show this works. So will they do that or will they make their qualitative data say what they want?" In some ways, CSA technologies have been integral to fostering elements of food sovereignty in the Cauca climate smart village as they have increased farmer control over local production of crops for consumption and have been part of efforts to revitalize seed networks and traditional crops. Despite the contributions of CSA to struggles for food sovereignty, CSA also presents limitations because of the ways it is entangled with the corporatization of a global food system, which has consequences for how a just food future can be imagined and enacted.

Changes in Local Diets: Assessing Food Security

As mentioned earlier, I used survey data from the 24-hour food recall conducted pre- and post-harvest along with qualitative interviews to determine how consumptions patterns had changed following the implementation of the CSA gardens and biofortified beans. In general, these data reveal that overall consumption patterns as related to the percentages of different food groups that compose diets did not change following the implementation of CSAs. However, the data reveal the consumption of a wider variety of healthy foods (a wider variety of vegetables) following the implementation of CSAs. Qualitative interviews provide insight that any changes in the food system are less directly related to CSAs and more closely related to community processes of consciousness raising and mobilization of CSAs to transform food systems.

An analysis of the 24-hour food recall data at the level of food groups (proteins, vegetables, fruits, dairy, etc.), revealed that both pre- and post-harvest there is minimal difference in consumption patterns related to the categories of foods eaten between households with and without CSA gardens. On the days when I conducted the survey pre-harvest, in households with CSA gardens, 40% of the total food consumed were vegetables, 17% were sugars and fats, 13% were cereals, 7% were proteins, 3% were fruits, and the remaining 20%

were spices and condiments or water. In households without gardens, I found comparable percentages: 33% vegetables, 27% sugars and fats, 16% cereals, 9% proteins, and 15% spices and condiments or water. Post-harvest, the percentages of total foods consumed remained roughly the same, indicating that overall diet was not changed by an influx of money nor by the absence or presence of a CSA garden.

A closer look at the types of vegetables and herbs—the foods that are produced through the use of CSAs—reveals that, pre-harvest, households with CSA gardens consumed a wider variety of fruits and vegetables. In households with CSA gardens, of the total number of vegetables consumed, 25% were starchy vegetables (primarily plantains), 4% were legumes, nuts, and seeds, 9% were dark green vegetables (mainly swiss chard), 13% were Vitamin A rich vegetables (tomatoes, squashes, carrots), 20% were fresh herbs, and 26% were other vegetables (mainly lettuce, cucumbers, or celery). In households without a garden, 51% if the total vegetable consumption was composed of starchy vegetables (mainly plantains) with only 26% allotted to the category of other vegetables, 18% to Vitamin A rich vegetables, and 5% to herbs. This would suggest that CSA gardens are responsible for increasing the diversity of foods consumed.

However, what I found post-harvest was that there was little difference between the categories of vegetables consumed in households with a CSA garden and without a garden. This suggests that increased income has the same effect on diet as a CSA garden. However, qualitative interviews gave me other insights into what processes—apart from capabilities to produce foods locally because of CSAs or increased income—were causing changes in consumption patterns.

Following the advice of Ecohabitats, I began to work in the community of San Antonio in February 2018. San Antonio was officially part of the Cauca climate smart village, but very few community members had implemented CSAs—only two individuals in the community at that time had CSA gardens—and the community had generally not participated in any of the activities related to the implementation of CSAs. San Antonio was roughly a 45 minute motorcycle ride away from Los Cerrillos where most of the activities that were part of the implementation of CSAs were held, making participation in these activities by residents of San Antonio difficult. During the first meeting I held in San Antonio, my short-term research assistant (Jorge) and I spoke about the food system and the work we were doing in Los Cerrillos with community members to analyze the impacts of the CSA gardens. I planned to ask if community members would lend me a bit of their time for the 24-hour food recall surveys and to inquire how I could best support them in return.

At the meeting, after sharing the problems that they had experienced with the local food system, several community members became motivated to organize a group to begin working toward correcting the problems that they had identified. One of the primary solutions they identified was the implementation of household gardens. I began meeting once or twice weekly with this group to construct gardens at each of their houses, clumsily joining in on all aspects of construction as I learned from members of the group how they made their bamboo-bordered raised beds. As momentum built, we began soliciting workshops and financial support from different governmental agencies that work in rural communities and attended workshops on preparation of healthy foods and techniques for garden construction.

The members of this group shared that they became more selective about what they were eating and serving their families and made more attempts to seek out organic foods and eat fruits

and vegetables from their own farms because of their participation in this workgroup. Our discussions at meetings revolved around these topics and some women became interested in nutrition and cooking healthy foods. Although most of the gardens that we built between February and July (when the second 24-hour food recall survey was conducted) were not planted during this time, there was a large shift in consumption patterns because of the consciousness raising process around food that was related to participating in this group and to learning about food sovereignty rather than the implementation of a practice or technology.

A similar consciousness raising process occurred in Los Cerrillos, El Danubio, and Las Mercedes, the communities participating most heavily in activities related to CSA and where I interviewed families with CSA gardens. In the summer of 2015, I attended a series of workshops run by Ecohabitats on food sovereignty and diets. This was one of the few meetings in which the term food sovereignty was discussed at length in the communities composing the Cauca climate smart village. While community members at this meeting were aware of general problems with the food system, they spoke about the problems in opaque terms, noting that they needed to "secure food" (*segurar la alimentación)* for the community and that there was a "lack of culture about food security."

Nearly three years later, when I began interviews in February 2018, most community members (men and women) that I spoke with identified the same three problems with the local food system and articulated clearly how the CSA gardens offer a corrective to these issues. Men and women spoke about the problems with purchased food containing chemicals because of conventional production methods, a lack of diversity in consumption patterns in the community (fewer food groups consumed because families tended to eat the same foods daily), and the consumption of unhealthy foods. Farmers frequently commented on the irony of being a farmer

and purchasing most of the food they consumed at home from city markets, reflecting their failures to produce adequate food for their families.

Farmers were cognizant that a long history and broad structural inequalities had contributed to the limitations of their diet and problems with their contemporary food system. Referring to what their parents and grandparents ate, many women reflected on the ways that their foodscapes had changed over time because of the intensification of coffee production encouraged by the National Federation of Coffee Growers (*la Federación Nacional de Cafeteros* who are most well known for their *Juan Valdez* coffee shops). In the 1970s, national coffee production expanded rapidly as new varieties and technologies of production made intensification possible and desirable. The new varieties demanded full sun exposure and chemical fertilizations, which resulted in clear cutting strategies and the elimination of shade trees, many of which were fruit trees that had provided a source of food. Expansion of coffee fields and the broad replacement of subsistence farming with large-scale monocultures and capitalist modes of agro-production across Colombia also resulted in the loss of traditional crops and disappearing knowledge (Comacho 2011; Piniero 2015; Taussig 1978). There was constant discussion, tinged with regret, about the loss of fruit trees and other means of subsistence farming or foraging in Los Cerrillos, even as efforts to recuperate agrobiodiversity had been under way prior to the introduction of CSA with the replanting of fruit trees within coffee plots.

In addition to pointing to the expansion of coffee and, subsequent shifts in land use, farmers pointed to the loss of control over the means of production as a key contributor to the failures of the local food system. In particular, farmers took issue with the seeds that they purchased in Popayán because they were produced through conventional means and sometimes, they told me, did not germinate or reproduce after the first planting. This broad perspective of the

issues associated with their local food system, led farmers to use CSAs not simply to increase their production, but to take steps to increase control over all parts of the food systems from production to consumption. In other words, farmers highlighted achieving food sovereignty as a central aim of transforming the local food system, moving beyond CCAFS aims of increasing production or access to nutritional foods. The CSAs they deployed were used to catalyze seed exchanges, recuperate traditional varieties, and overall increase local control over the modes of food production.

Using CSAs to Increase Local Control of Production

Despite limited changes in diet following the implementation of CSAs, the data collected indicated that there were increases in the consumption of locally produced food, suggesting increased control over production of crops for consumption. Control over the food system and modes of production is an important marker of food sovereignty and highlights food as a human right through providing the conditions for communities to determine and develop their capacities for producing and consuming foods that align with their "cultural and productive diversity" (Via Campesina 1996; Patel 2009). The changes over local control of the food system were largely driven by women who, as explained in the previous chapter, were the primary caretakers of gardens, the spaces where most of the food for consumption was grown.

When asked where the foods consumed during the 24-hour food recall were from, farmers with CSA gardens reported that 56% of their total foods consumed pre-harvest were from their farms or from other local farms. Only 30% of the total foods consumed during the same period by farmers without a garden were produced locally. Similarly, post-havest 46% of the total food consumed in households with a CSA garden were produced on local farms compared to 28% of foods consumed from farms in households without a garden. While it is certain that there was greater consumption of locally produced foods in households with CSA

gardens than in households without gardens, it is not clear that the adaptive technologies as designed by CCAFS were key to increasing locally consumed foods.

By the time I conducted interviews in the post-harvest season (July), many women had discarded the technologies that differentiated a CSA garden from a traditional garden (the plastic covering and drip irrigation system). Other women had been unable to afford the large storage tanks of water that CCAFS envisioned would accompany the gardens in the first place or, as I mentioned earlier, had difficulties keeping them filled for more than two or three days. Many CSA gardens generally looked and operated like the traditional gardens I had seen in my first years of fieldwork in the communities, which many women planted only when the weather permitted. One of the only differences was that most CSA gardens were much larger than the gardens that women had before the arrival of CCAFS and Ecohabitats.

However, the few women who successfully managed the suite of adaptive technologies (the plastic, the water tank, and the drip irrigation) claimed that the host of technologies had been key for the consistent production that they were able to maintain throughout the year. As Luisa described when asked whether the CSA technologies used in the gardens were effective:

> Principally, the garden is very, very, very, very, very….how can I say this? Very beneficial in this sense. The plastic is protecting the plants from direct sunlight…and the most important is the water, that I have the [water] tank there to be able to water [the plants], I mean to "harvest water" from the rain. That's the most important. Because during the summer water is difficult, it's true! And the *malla* (the netting around the garden) because if [it wasn't there] the chickens and everything wouldn't leave me any plants. And the land, well it's plenty of space and everything, so that benefits me a lot. Because of these reasons, the adaptive technologies have been magnificent.

Not all women agreed that the gardens were beneficial, commenting on how technologies complicated production.

As described earlier, some women turned to materials they already had experience with, to modify their gardens and they were generally pleased with how their gardens thrived under

these adaptations to CSA. There were questions among researchers in CCAFS as to whether these adaptations to their models of CSA gardens were still considered CSA gardens or if they were no longer the design (and intellectual property) of CCAFS. Notwithstanding this uncertainty over what qualifies as a CSA and what does not, women generally reported that they had increased their on-farm production of food and, because of this and because of newly created networks of trading or purchasing food from one another, they were purchasing fewer food products from Popayán.

In general, the CSA gardens led to development of new and to the strengthening of pre-existing informal exchange networks that became integral to maintaining friendship and kinship networks. As mentioned in chapter four, women began to trade or sell their surplus produce and herbs, gaining access to crops that they had not produced themselves in their gardens. While the exchanges of foods and knowledge were integral to creating pathways of food sovereignty, forming seed networks was perhaps the area where women invested most of their energy and resources because it gave them easy access to agricultural inputs that they could then decide how to use on their own farms.

Seed exchange networks were among the most important networks, because the exchanges of seeds led to increases in agro-biodiversity, to the recuperation of traditional production strategies and knowledge, and to the strengthening of a sense of community. There is evidence that kinship networks shape seed exchanges within farming communities and that women frequently play a primary role in seed exchanges as a strategy of responding to climate related emergencies (Labeyrie 2016). My research demonstrates that seeds also shape social networks as women habitually employ these low value agricultural inputs to forge and strengthen relationships and increase control over modes of production.

In the Cauca climate smart village, there were two overarching patterns related to seeds. On one hand, the implementation of CSAs saw an increase in the overall diversity of seeds circulating because of increases in seed sharing to plant CSA gardens and because of the introduction of biofortified seeds, which farmers were also encouraged to share or sell within the community. Despite these gains, the introduction of biofortified seeds limited the possibilities of creating diverse food systems and the power and control of local communities over their food systems.

As Celia pointed out, the primary "benefit [of the CSA gardens] has been seeds." Although in the past many women had shared seeds, they often bought seeds because they only maintained gardens during one period of the year. Celia also noted that, before the CSA gardens, saving seeds from one planting season to another often resulted in "damaged" seeds, necessitating that women purchase them yearly rather than save them for the next planting cycle.

Following the implementation of the CSA gardens, women told me, they had begun to save seeds more diligently, sometimes, like Arelia, filling large plastic jars to the brim with far more seeds than they could ever plant. Seed saving often resulted in women freely sharing seeds with neighbors and friends. As noted in chapter four, some women began to carry seeds in small pieces of paper or plastic in their pockets as they visited friends or attended meetings, with the intent of sharing the seeds. Although seed sharing was most often a reciprocal act, there were instances in which women shared seeds and did not receive any in return despite knowing that other women had desirable seeds. Celia described her frustration to me about sharing seeds and not receiving any in return. She ultimately decided to only share seeds with women who shared seeds with her, excluding from her seed network any women who did not reciprocate by sharing their own seeds.

In addition to creating or strengthening social networks, the informal exchange of seeds and plants gradually resulted in the integration of more seed varieties. This is a pattern that is well documented among farmers across contexts and one that has been linked to greater community-wide crop diversity (Ban and Coomes 2010; Delêtre et al. 2011; Perales et al. 2005. Carolina explained to me how the exchanges often came about:

> For example, one day when we were in a training I talked with one of the women who was there and she told me that she had a kind of onion that is "cool" (desirable). So we did an exchange (*intercambiamos*). I gave her some oregano plants and she gave me some onions. So there [at trainings] we do exchanges too, this is really beneficial, because I had already run out of onion [when I got it through this exchange] so I was able to plant onion again [because of the exchange].
> Molly: And so because of the exchanges you also have more products in your gardens?
>
> More Diversity?
>
> Carolina: Of course. It's the best.

A link between agro-biodiversity and increased adaptive capacity and food security has also been well established, suggesting that increased diversity of crop varieties in Cauca will serve to strengthen farmers' preparedness for and resilience to climatic events and shocks as these phenomena continue to worsen (Jackson et al. 2010, among others).

Occasionally, when I visited CSA gardens with Carmen, she would exclaim upon seeing a variety of crop that she either did not recognize or that she recalled from her childhood. This inevitably led to a conversation with the woman who owned the garden about the crop, and often ended in Carmen carrying away one or two of the fruits or vegetables to extract seeds from and plant herself. Carmen and other women were also active in collecting seeds from other communities and, as Carmen called it, "experimenting" with them on their own fincas before sharing seeds with other women.

Most of these new crops were different varieties of cherry tomatoes that Carmen had collected from other farmers outside of the Cauca climate smart village and she diligently dispersed these seeds or gave away young plants each time she visited someone's finca or they visited hers. Other crops that appeared following the CSA gardens were heirloom varieties of both spicy and sweet peppers that women noted their grandparents had grown, but that had not been widely present in the communities for years. Tomatillos first appeared several years ago when one farmer planted seeds that he had been given by someone outside of the communities; great confusion followed as to how to prepare and eat them—no one showed interest in creating the spicy salsas that I mentioned they were used for in Mexico—until Carmen recommended adding them to salads.

Apart from obtaining new seeds from expanding seed networks, profits from selling crops from the gardens were often funneled back into the gardens through the purchase of seeds from Popayán, slowly expanding the diversity of crops that women grew. Together with women from Los Cerrillos and El Danbio, Daniel and I helped launch a seed bank where farmers could freely access seed varieties that they did not have and leave those varieties of which they had an excess. Although I am uncertain as to whether women continued to develop the seed bank after my departure, their conversations about this initiative revealed the importance of accessing seeds produced without chemicals for women in the communities.

Despite the overall increase in the quantity of seeds circulating, CSA presented certain limitations to creating seed networks that supported agroecological and sovereign modes of production. This was largely because CCAFS did not support obtaining seeds outside of the context of providing biofortified varieties. CCAFS concerned itself with seeds only when they were the producers of the seeds. Although CCAFS encouraged farmers to implement their

model of a climate adapted garden and then widely subsidized the implementation of this model by farmers, they did not offer support—financial or logistical—in obtaining seeds for the garden. Farmers were left to figure out how to get seeds and many continued to purchase conventional seeds at small shops in the nearby capital city despite their concerns over the chemicals used to produce these seeds.

CCAFS' efforts in disseminating seeds were centered around the biofortified and resistant varieties produced within CIAT. The promotion of these engineered seed varieties over local varieties may be what Peter Newell (2009) refers to as biohegemony, whereby certain types of seeds, productive practices, and biotechnologies are promoted over others as they map onto global power flows shaped by neocolonization under the Green and New Green Revolution. In Cauca, CSA has resulted in CCAFS' valuing of scientific and bioengineered production over traditional practices. This has led CCAFS to financially and logistically support the development and promotion of their seeds rather than traditional varieties.

CSA has inevitably impacted the varieties of crops present in the Cauca climate smart village, as a limited number of biofortified varieties are grown, shared, and relied on in place of traditional varieties that could potentially be recuperated locally.[13] Biodiversity is important for ensuring a future food supply, preserving traditional food ways that are at the center of livelihoods and food sovereignty, and for the long term sustainability of agricultural and food systems. Biofortified foods may undermine goals to conserve biodiversity (Johns and Eyzaguirre 2007). Although CCAFS claims to support agroecological practices, its dependence on

[13] Although there are no estimates about the number of traditional bean varieties in this region of Cauca, Laura Gutiérrez found that seed savers in another community of Colombia, Riosucio, have as many as 12 traditional varieties that they consider native to their community and the area surrounding it (2016). It seems likely that just as many varieties could be recuperated locally in this region of Cauca.

replicating biofortified seeds (and other agricultural technologies) to achieve large scale impact undermines these intentions and limits the ability to create the "transformed food systems" identified as CCAFS' high priority.

CHAPTER 6: CONCLUSION

During my last few days in Cauca, I was finally able to have a formal interview with Liliana, who had recently returned from the climate smart village in Guatemala where she was conducting research for her dissertation. She was emphatic as she described the frustrations of working within the limitations of the CGIAR and the challenges that she had encountered in Guatemala related to the lack of infrastructure and resources. Near the end of our conversation, she remarked that CCAFS would slowly start to withdraw from the Cauca climate smart village because they considered their work there to be coming to an end.

I was very surprised to hear that CCAFS was withdrawing funding, despite having heard rumors that CCAFS' financial situation had been tenuous for several years as funds dried up or slowed down. I had expected many more CSAs to be piloted in Cauca and for the dynamics of the process of adaptation to be carefully tracked for years to come. Rather, according to Liliana, CCAFS seemed to think that the Cauca climate smart village was a success and that the rapid replication and scaling out of practices and technologies to other sites could now become the focus of CCAFS' efforts.[14] The removal of funding from local communities to funnel finances toward supporting the wide expansion of technological and biotechnological fixes created by

[14] During this time, CIAT was also in the midst of discussing a merger with the European-based Bioversity International, another center that conducted "research for development" similar to the centers in the CGIAR. I attended numerous talks at CIAT during the 2018 Annual Program Review that addressed the merger to both calm staff fears of losing their jobs or funding and to strategize about how to leverage the research strengths of CIAT to avoid losing departments or research focuses that those within CIAT considered integral to their mission. It is likely that the merger affected CCAFS' ability to support ongoing work in the Cauca climate smart village because of anticipation that funding might become more restricted.

research institutions such as CIAT is a divestment from community-centered futures. Further, this move to expand and reproduce technologies created by research institutions marks local farming communities as unsustainable and maladaptive.

I have heard from local collaborators since leaving the country that they continue to implement the BSA beans and are looking forward to obtaining the newly released biofortified and disease-resistant corn to plant as well. Every few months, Carmen or Sofia sends me pictures of newly planted fields, advertisements for the local organic farmers market that producers from the Cauca climate smart village participate in, and community gatherings where seeds and produce are exchanged; they comment on the ongoing participation of women in transforming the community. While it is possible that the community members in the Cauca climate smart village feel the absence of CIAT's support as a sort of abandonment, it is clear that they continue to forge local futures through strengthening the local food system.

Main Findings and New Developments

In many ways, climate smart agriculture is about the creation of futures. Visions of a technologically advanced future emerge through CSA as researchers at CIAT dream up plans to modernize the global food system, training smallholder farmers in technologies developed by the very methods of production that caused climate change. Further, while CSA attempts to integrate smallholder farmers and their families equitably into this vision of the future, it unwittingly perpetuates inequalities at a global and local level by placing the burden of achieving future food security on smallholder farmers and by perpetuating gendered inequalities related to labor and production.

CSAs were developed and leveraged to address narrowly defined problems; to prepare for anticipated food scarcity and insecurity at a global level and to empower women at a local level through increasing their incomes. While seeming to center the visions for the future of

smallholder farmers by using participatory methods, smallholder farmers were integrated into the development of CSA in perfunctory ways. Rather than ground the development of CSAs in the values, perspectives, and opinions of farmers, CSAs traveled from CIAT to Cauca with the objective of being planted or otherwise implemented.

Farmers, in effect, became the testers of CSA rather than co-producers. This, in turn, resulted in an imposition of technological imaginaries of the future as local visions and local knowledge were understood to be secondary to—rather than equal to—scientific knowledge. Farmers were, and continue to be, essential to the spread of CSAs as it is their labor that will secure global food security, ensured by farmer integration into global markets where foods flow from the Global South to the richer and more powerful Global North (Holt-Giménez and Altieri: 2013).

In the implementation process, inequalities shift as farmers are both limited by CSAs and as farmers leverage these tools and technologies to challenge local power dynamics. CSAs are framed by governments and CIAT as improving farmers' livelihood opportunities and food systems and empowering women. However, the assumptions that underpin improvement ultimately present limitations to farmers. A transformed food system—one which is equitable and guarantees food security globally—achievable through CSAs relies heavily on biotechnologies, which do not offset the historical inequalities in experiences of hunger and simultaneously burden smallholder farmers with maintaining a global food supply. Similarly, by relying on economic empowerment to solve gendered inequalities, CSA is unable to address the root causes of systemic gendered oppressions, which in turn reinscribes unequal gendered power dynamics.

While other researchers of CSAs are in agreement about these limitations (Collins 2018; Gonda 2016; Taylor 2018), I also found that CSA created opportunities for farmers in Cauca, and specifically for local women, to challenge inequalities and to work toward food sovereignty. Because the CSAs implemented in Cauca encompassed infrastructural components, men were drawn into spaces of work—like gardens—that had traditionally been relegated to women. Little by little, in many households, women have reported men becoming more engaged in other household responsibilities (such as caring for children or cooking) that their wives, mothers, or sisters had previously managed in addition to other on-the-farm labors carried out by women. Some women also leveraged the physical space of the garden to engage their husbands in conversations, which these women described as leading to newfound mutual respect between themselves and their spouses. In general, because the CSAs implemented in Cauca drew on women's knowledge and expertise, many women described the work that they performed as being recognized within their families for the first time, which, in turn, led to increased respect for women and their contributions to their families and farms.

Most importantly, CSAs laid the groundwork for the development and strengthening of community economies (J.K. Gibson-Graham 2016). Rather than integrate into capitalist markets in nearby cities, women used the surplus and seeds from their gardens to build relationships with neighbors, friends, and family members by trading or gifting small amounts of these agricultural products. The informal networks that emerged served, as women described it, to strengthen feelings of unity and community and to diversify the food system.

CSA is a key part of a broader strategy headed by CCAFS to transform food systems globally. At the center of this strategy is the concept of food security, which is largely achieved through short term technological implementations mobilized to increase production. In other

words, I argue that CCAFS' focus on future food security—and the technologies and methods deployed to ensure it—will not create a long term sustainable food system that meets the specific cultural and health needs of communities throughout the world. Despite the limitations that CSA presents because of its focus on food security, the community economies that women in Los Cerrillos, El Danubio, and Las Mercedes invested in, and the strategies of gifting and trading that formed the basis of these economies, resulted in an increase in the diversity of local food crops. Women and men from these communities also frequently commented on how the CSAs had given them more control over what they and their families consumed by increasing their immediate access to crops grown without chemicals and to a wider variety of foods. Although limiting, CCAFS' approach to transforming food systems did open up spaces for community-wide investment in local food sovereignty.

Since I left Colombia, Mariana—one of the leaders of the association Tierra, Vida y Amor that I worked with closely in San Antonio—has told me that many members of the association have planted the CSA bean varieties and that they have had success with the harvests. Periodically, over Whatsapp, messages come in to her from farmers or researchers with CCAFS in Guatemala, Colombia, and Nicaragua sharing the results of new projects. Most recently, since the spread of COVID-19, Jimmy sent pictures of community members in Los Cerrillos and El Danubio bagging crates of mangos and other foods harvested from their farms and loading the bags into a truck to take to Popayán to donate to those in need during the crisis. This likely would not have been possible during the first years I worked in Los Cerrillos, reflecting how the food system has changed locally as well as how women and men have become invested in a politics of reciprocity and solidarity catalyzed by their efforts to implement CSAs.

In this dissertation, I have presented both the limitations of CSA and also the possibilities that it brought to farmers in the Cauca climate smart village to imagine and enact anti-capitalist, sovereign, and just food futures. Despite the positive changes that CSA catalyzed in Cauca, ultimately I argue that CSA has failed to provide a transformative approach to the agricultural sector that would guarantee long lasting, sustainable food systems and equitably feed a world confronting challenges associated with climate change. A truly transformative approach would center the visions and perspectives of local communities as they form economies, technologies, and futures outside of the limitations of a system invested in capitalist accumulation.

Limitations and Future Research

While there has been extensive attention to the direct effects of climate change on local communities globally (Crane et al. 2011; Nelson and Finan 2009; Nuttall 1992) there has been far less research on the material and social consequences of adaptive technologies and practices, including the effects of CSA technologies on the food system, food security and food sovereignty (Beuchelt and Badstue 2013; Di Falco et al 2011). My work has analyzed these consequences in the present moment and as part of anticipatory practices by drawing from the notion of a sociotechnical imaginary to explore how CSA in the present moment lays the groundwork for future inequalities on a local and global scale (Jasanoff and Kim 2015).

Several aspects of CSA were beyond the scope of this project. Because I approached CSA as it is implemented in the Cauca climate smart village, I did not collect extensive data on the dynamics of the CGIAR and CSA at the highest institutional levels. Undoubtedly, the corporations backing CSA (like Monsanto and other multinational corporations) listed on the CCAFS' webpage and the United Nation's Intergovernmental Panel on Climate Change have varying degrees of influence over the shape of CSA. Further research is needed to explore how these global actors shape the CSAs that are eventually sown at the local level. Particularly as the

CGIAR merges with Bioversity International and as CCAFS turns more serious attention to "transforming food systems" and creating alliances with the private sector, more research is needed to understand these entanglements and how they shape CSA.

Likewise, as CSAs are scaled up and out across Colombia and other parts of Latin America, research will be needed to understand how local context influences the success or limitations of CSA, including how CSA might be unintentionally reproducing or deepening pre-existing inequalities related to gender, race, and class. Because CCAFS is interested in deploying CSA as a set of scalable adaptive technologies and practices that can be applied with the same results across other local contexts, more research is needed to explore how local context shapes the effects of the implementation of CSA on local communities. With more detailed knowledge of how local power dynamics shape CSA use and impacts, CCAFS might be able to avoid reproducing or worsening pre-existing inequalities. Additionally, more research is needed into the effects of CSAs that were implemented outside the Cauca climate smart village to understand the impacts and limitations of other CSA technologies or practices.

Creating Sustainable and Equitable Futures

As climate change increasingly makes production difficult for farmers within and outside of Colombia (IDEAM 2010; Yadav et al. 2015) there is an urgency to finding solutions to ensure future food production. Although CSA promises to address both climate change and food insecurity, the sociotechnical imaginaries that guide CSA fail to address the root causes of inequalities underlying the experience of hunger and the negative effects of climate change. In order to contribute to a just and sustainable future, there must be investment in strategies that strengthen community economies and the biodiversity of our food systems rather than simply increase total production of foods as CSA primarily aims to do (Jackson et al. 2010).

Although recommendations should be tailored to the dynamics of a particular context, there are certain lessons from the Cauca climate smart village that I argue could be extended to other climate smart villages and, more generally, to the development and implementation of biotechnologies. First, farmers should be positioned as co-creators of knowledge, rather than as recipients. This positioning of farmers as co-creators moves beyond participatory strategies of research in which farmers contribute local knowledge, asserting instead that their knowledge systems are just as valid as scientific and Western knowledge systems (Cruikshank 2004). In Cauca, such respect for local knowledge could have led to the use of permaculture to produce food for households, mirroring the production strategies of current community members' parents and grandparents (see the discussion at the end of Chapter Three on "A Turn to Tradition").

Relatedly, attention and time should be given to creating communication networks among farmers and between farmers and researchers (that are not only centered around data collection and dissemination). A central barrier identified by farmers to increasing community-wide access to healthy foods was a lack of communication and knowledge sharing. Farmers were eager to alert neighbors about surplus crops that they were interested in selling or sharing, but had little ability to do so because of limited access to cell phones and to cell and wifi-signal in the context of a rural community where homes are often isolated and remote. Supporting networks of communication would also facilitate knowledge sharing about productive and social life among farmers and between farmers and researchers. This in turn would recognize farmers as producers of knowledge rather than as recipients and create possibilities of collaboration in developing and disseminating CSAs. Similarly, it would provide researchers with a more holistic understanding of the barriers to sustainable and healthy food systems beyond the productive sphere, and give

them insight into the social dynamics that shape vulnerability to climate change (such as those that I mention in Chapter Three and Chapter Five).

Finally, CSA should adopt a more holistic perspective in supporting food production from seed to crop in order to strengthen bio-diversity of local food systems. Although biofortified foods might be part of this objective, in Cauca, key interventions in assuring biodiversity, and therefore long-term sustainability of food systems, were lacking. In Cauca, farmers needed to be supported in gaining access to a wider variety of seeds produced through sustainable means that could then be planted in the CSA gardens. In other communities, supporting biodiversity might look like exploring best practices for planting—including, perhaps, training farmers in the value of direct versus indirect seeding for certain crops or in using drip irrigation systems effectively. By emphasizing the scaling up and out of a technology, CCAFS became hyperfocused on reproducing the technology. This ultimately meant that support was not always provided for productive practices like selecting seeds, which fell outside the scope of the direct use of the technology. If farmers had been supported in finding solutions to seed-related problems (lack of seeds, access only to GMO seeds, or seeds that were considered undesirable), many more CSA gardens might have flourished.[15]

My dissertation illuminates some of the strategies that local farmers employ to move beyond the limitations of a technologically dependent and capitalist food system. By centering community unity and by using the past as a reference point for the future, women farmers integrate a politics of care into agricultural production that contributes to adaptive capacity by bolstering biodiversity and strengthening social support networks. Technologies alone will not

[15] Frequently, when I visited gardens, farmers would pull out packets of seeds that they had purchased in Popayan and ask me why I thought that they were not producing or explain to me that they had hoped, but failed, to obtain organic seeds. This signaled to me that support beyond implementing the garden infrastructure was needed.

save us from climate change (Fry 2015). Rather, there is an urgent need for investment in futures that offer alternatives to the capitalistic and technologically driven ones like the CSA model. Farming communities such as those in the Cauca climate smart village have repurposed the CSA model to afford such an alternative model. In them, we find that technology is integrated in ways that challenge status quo power dynamics and that work to build communities of care and reciprocity so as to ensure their future survival and a more just food system.

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